School of Occupational Therapy, Social Work, and Speech Pathology

Understanding cognitive and psychosocial correlates of spoken discourse skills in adolescents with and without acquired brain injury.

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Doctor of Philosophy
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Declaration

To the best of my knowledge and belief this thesis contains no material previously published by any other person except where due acknowledgement has been made. This thesis contains no material which has been accepted for the award of any other degree or diploma in any university.

The research presented and reported in this thesis was conducted in accordance with the National Health and Medical Research Council National Statement on Ethical Conduct in Human Research (2007) updated March 2014. The proposed research study received human research ethics approval from the Curtin University Human Research Ethics Committee (HRE2016-0349 and HRE2016-0219), Catholic Education Western Australia (June 2017; RP2017/31), and the Department of Education Western Australia (May 2018; D18/0182330).

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Peer-reviewed Publications Arising from this Thesis

Published

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Authorship attribution statement:

As lead author, I was primarily responsible for study conception and design of the research question, development of search strategies (and inclusion / exclusion criteria) and conducting searches. I also directed data extraction from title to full-text screen, and analysis and interpretation of extracted information. I lead discussion of the findings in light of past literature and theory and was responsible for writing the manuscript, final approval and submission. All co-authors assisted in the conceptualisation of the research question and development of the search strategy, systematic review method, and assessment of risk of bias. All co-authors participated in at least title (MC, AW, MB, RW), abstract (MC, AW, RW), and/or full-text screening (AW, RW). All co-authors were involved in interpretation and discussion of results, editing the manuscript, and in final approval prior to submission.

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Authorship attribution statement:

As first author, I was responsible for leading the conceptualisation of both studies (#2 and #3). I was also primarily responsible for participant recruitment, data collection, and preparation. I also conducted the statistical analysis, with the guidance of MB, and was predominantly responsible for interpretation, discussion, and writing the manuscript and for final approval for submission. All co-authors contributed significantly to conception and study design of both studies, and guided the method of recruitment and data collection (choice of assessment tasks etc). MC and AW were involved in the development of the Curtin University Discourse Protocol – Adolescent version and psychometric testing (inter-rater reliability). MB was closely involved in method and interpretation at each stage of statistical analysis. All co-authors closely involved in interpretation of discourse data in light of broader literature and theory related to adolescent discourse and were involved in editing the manuscripts and provided final approval prior to submission.

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Hill, E.(2019). *Discourse in adolescent brain injury: An overview.* Presentation at the Australasian Society for the Study of Brain Impairment (ASSBI) Study, Work, and Volunteer with Individuals with Brain Injury, Perth, Australia.

Hill, E., Claessen, M., Whitworth, A., & Boyes, M. (2020). *The influence of genre on adolescent discourse* [Conference session]. Speech Pathology Australia National Conference, Darwin, Australia.

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List of Abbreviations

ABI	Acquired brain injury
ACARA	Australian Curriculum Assessment and Reporting Authority
ANCDS	Academy of Neurologic Communication Disorders and Sciences
ASD	Autism Spectrum Disorder
BRIEF	Behaviour Rating Inventory of Executive Function
CASP	Child and Adolescent Scale of Participation
CELF-4	Clinical Evaluation of Language Fundamentals – Fourth Edition
CIU	Correct Information Unit
CLS	Core Language Score
CUDP	Curtin University Discourse Protocol
CUDP-A	Curtin University Discourse Protocol – Adolescent
DKEFS	Delis Kaplan Executive Function System
EBP	Evidence-based practice
ICF-CY	International Classification of Functioning, Disability, and Health: Children and Youth Version
LCQ	La Trobe Communication Questionnaire
MANOVA	Multivariate analysis of variance
MFAD	McMaster Family Assessment Device
MLUw	Mean length of utterance (words)
PCA	Principal Component analysis
PedsQL	Pediatric Quality of Life Inventory
RAVLT	Rey Auditory Verbal Learning Test
SALT	Systematic Evaluation of Language Transcripts
SBF	Structure Building Framework
SCSA	School Curriculum and Standards Authority
SSRT	Stop-signal reaction time
WHO	World Health Organisation

Copyright Statement

Abstract

Cognitive-communication deficits associated with paediatric acquired brain injury (ABI) can persist well into the adult years and influence participation across academic and social environments. For adolescents, these deficits can create challenges when navigating increasingly complex social, academic, and emotional demands. Discourse skills provide an ecological focus for clinicians and researchers to examine the influence of cognitive-communication deficits on real-world functioning. Clinical recommendations encourage speech pathologists to consider the cognitive and psychosocial factors associated with discourse impairments during assessment and treatment planning. There is a paucity of evidence available, however, to guide clinical decisions, as the nature of the relationships between communication, cognitive, and psychosocial outcomes following paediatric ABI remain largely unknown. This thesis sought to examine the cognitive and psychosocial correlates of discourse in adolescents with and without a history of ABI through a targeted program of research that would advance speech pathology practice with this population. Six discrete, but interrelated, studies were undertaken.

A systematic review of the literature was conducted to explore links between cognition and discourse in speakers with ABI, and to inform subsequent studies in the research program. Four key findings emerged from the review. The results provided strong evidence for a relationship between cognitive and discourse impairments in speakers with ABI, particularly deficits in memory and executive function. These relationships aligned with Gernsbacher's Structure Building Framework (SBF), which provided support for the use of this model in ABI. The review also highlighted inconsistency in methodology and terminology across studies, particularly in the elicitation and analysis of discourse. Finally, the results underscored the paucity of literature surrounding relationships between domains in *paediatric* ABI, and the degree to which these relationships differ from what is expected of children and adolescents without brain injury. In order to understand the state of current clinical practice, this thesis involved an international survey to explore assessment and treatment patterns for discourse in paediatric ABI. The findings indicated that, while clinicians aspire to adhere to available clinical recommendations, their efforts are impeded by a lack of assessment tools and normative reference data.

In response to this, the research program developed of the Curtin University Discourse Protocol – Adolescent version (CUDP-A). The tool was piloted on a large adolescent reference sample (N=160) to profile word to whole-text level language features, and analyse age- and genre-related differences. The results provided support for the CUDP-A as a useful protocol for assessment of adolescent discourse skills, and with considerable variability found in adolescent discourse skills, particularly across word and sentence-level measures and across genres. This adolescent discourse data further enabled exploration of the cognitive and psychosocial factors associated with discourse in adolescents without ABI. Discourse features were found to be related to cognitive function, and these relationships were largely consistent with those discussed in the systematic review. The link between discourse and psychosocial health was more ambiguous, which highlighted the need for ongoing research in populations at risk of reduced psychosocial wellbeing such as those with ABI. Drawing on the results of earlier studies, the CUDP-A was then piloted on two adolescents with ABI, and significant impairments in discourse skills alongside reduced cognitive function and psychosocial health were found. Tentative comparisons of patterns of impairment could be drawn relative to the reference sample and external literature.

This thesis makes a unique contribution to our understanding of discourse in adolescents with and without ABI, including implications for clinical practice and research. The CUDP-A provides clinicians with the opportunity to sample discourse across a range of genres, with scoring guidelines and reference data on a vast array of word to whole-text language measures. This tool will enhance our ability to assess adolescent discourse and identify treatment targets in clinical populations. This research provides novel understanding of the cognitive and psychosocial factors associated with discourse in adolescents without ABI and how brain injury may disrupt these relationships. The results support continued application of MacDonald's (2017) model of cognitive-communication, Frederiksen and Stemmer's (1993) model of discourse planning, and Gernsbacher's (1990) SBF to understand discourse in adolescents with and without ABI. The correlates of discourse skills in adolescents with ABI, particularly psychosocial factors, should remain a focus of ongoing research. Continued efforts should also be made to validate the CUDP-A and obtain reference data across other adolescent clinical populations.

Thesis Overview

The overarching aim of this doctoral research was to examine the cognitive and psychosocial correlates of spoken discourse in adolescents with ABI and the implications for clinical practice. The outputs of this work are organised into three parts.

Part One, comprises the first three chapters of this thesis. A comprehensive review of the empirical literature and theory that underpins this research program is presented in Chapter 1, providing the initial context and setting with the research aims. Chapter 2 (Study 1) presents a published systematic review of the literature exploring the relationships between deficits in cognition and discourse in speakers with ABI. While the first two chapters relate to current empirical evidence, Chapter 3 (Study 2) presents an international survey of clinical practice for the assessment and treatment of discourse in paediatric ABI as it relates to the empirical evidence reviewed in Chapter 1 and Chapter 2.

Part Two, comprises Chapters 4 and 5. In response to the findings of Studies 1 and 2, Chapter 4 (Study 3) presents a published study of the development of a novel assessment tool and the subsequent variability within, and developmental progression of, monologic discourse in a reference sample of adolescents without ABI between 12 and 15 years of age. This section also examines the influence of genre on discourse skills of adolescents without ABI in Chapter 5 (Study 4).

Part Three of this research program includes Chapters 6 and 7. Chapter 6 (Study 5) presents an exploration of relationships between discourse, cognitive and psychosocial variables in adolescents without ABI. Chapter 7 (Study 6) presents a pilot study of the CUDP-A in adolescents with ABI and draws on the correlate data from the adolescent reference sample to explore comorbid impairments across communication, cognitive, and psychosocial domains as they are illustrated in MacDonald's (2017) model.

Finally, Chapter 8 presents a General Discussion of the findings and implications from this program of research. This chapter interprets the findings in light of the previous literature and available theoretical frameworks. The theoretical and clinical implications from the six studies are discussed, and the limitations and future directions of this research presented.

PART ONE

Scoping the Literature and Current Practice

Chapter 1
Literature Review

Chapter Overview

The aim of Part One of this thesis was to review the current literature on discourse, and its correlates, in adolescents with ABI, and how clinicians currently assess and treat discourse skills in this clinical population, including an exploration of barriers and facilitators to clinical decision-making. Part One sought to identify current gaps in knowledge and clinical practice, which guided the formation of the research questions and variables of interest for the empirical studies of this research program.

The current chapter presents a review of the pertinent literature related to discourse in adolescents with ABI and links to cognitive and psychosocial outcomes. This chapter begins with an overview of the epidemiology of childhood acquired brain injury (ABI), followed by a discussion of cognitive-communication disorder in this clinical population and an introduction to MacDonald's (2017) model of cognitive-communication competence. In the context of this model, this chapter will move on to discuss the cognitive, communication, and psychosocial deficits associated with childhood ABI. Given the focus of this research program, this chapter expands, in particular, on deficits in discourse-level language within the communication domain. The literature review then moves into a discussion of current evidence of relationships between discourse deficits and cognitive and psychosocial domains in this population, as they are illustrated in MacDonald's (2017), and other theoretical frameworks. The chapter will then briefly describe current recommendations for assessment and intervention for discourse in paediatric ABI, including what is known to date of current practice patterns. Following a summary of the current gaps in the literature, this chapter will end with a statement of the broad research objectives addressed in subsequent chapters of this thesis.

Childhood Acquired Brain Injury

ABI is a leading cause of persistent and pervasive disability in children and adolescents (Faul, Xu, Wald, & Coronado, 2010). An ABI is defined as any damage to the brain that occurs after birth following a traumatic or non-traumatic event (Cullen, Park, & Bayley, 2008). While traumatic ABI results from accidental injury such as damage following a car accident, non-traumatic injuries are caused by medical issues or disease processes including inflammation, metabolic toxicity, neoplasms, or vascular episodes such as strokes (Cullen et al., 2008). Traumatic ABI makes up 1,373 of every 100,000 head injuries per year, while non-traumatic ABI occurs less frequently, accounting for approximately 82 per 100,000 injuries annually (Chan, Pole, Keightley, Mann, & Colantonio, 2016; McKinlay & Hawley, 2013). In Australia, almost 20,000 children under 15 years of age live with the consequences of ABI, with similar rates reported in other first-world countries such as the United Kingdom and the United States (Crowe, Babl, Anderson, & Catroppa, 2009; Faul et al., 2010; National Institute for Health and Care Excellence, 2014). Due to increased risk-taking behaviour and exposure to high intensity sports, driving, and assaults, traumatic ABI is increasingly more common in adolescence; particularly for young males (Asemota, George, Bowman, Haider, & Schneider, 2013; McKinlay et al., 2008).

The potential for long-term persistent deficits post-injury is increased in childhood due to the physiology of the child brain. During childhood and adolescence, the brain is still undergoing anatomical, physiological, and biomechanical development (Ommaya, Goldsmith, & Thibault, 2002). In particular, the child brain has a higher water content within the neural tissue and is surrounded by a weaker skull, making it less robust to injuries (Ommaya et al., 2002). As a result, most cases of childhood ABI experience long-term physical, cognitive (Anderson, Godfrey, Rosenfeld, & Catroppa, 2012), psychological (Max, 2014), and social impairments (Ryan et al., 2016). Studies have documented considerable evidence of a dose-response relationship on outcomes post-injury, with more severe injuries associated with greater deficits (Babikian & Asarnow, 2009; Crowe, Catroppa, Babl, & Anderson, 2012; Di Battista, Soo, Catroppa, & Anderson, 2012; Sullivan & Riccio, 2010). Consistent with the 'early vulnerability hypothesis', poorer outcomes are also associated with earlier age at injury, with those skills that are less consolidated at the age of injury more vulnerable to impairment (Cermak et al., 2019; Li, Risacher, McAllister, Saykin, & Alzheimer's Disease Neuroimaging Initiative, 2017; McKinlay, Dalrymple-Alford, Horwood, & Fergusson, 2002). Research also indicates that pre-injury cognitive and behavioural functioning, family function, and socioeconomic status are protective factors against persistent negative outcomes following paediatric ABI (Anderson, Catroppa, et al., 2001; Catroppa & Anderson, 2002; Renaud, Lambregts, van de Port, Catsman-Berrevoets, & van Heugten, 2020).

For approximately 60% of paediatric ABI cases, neuropsychological, communication, and psychosocial impairments will persist into the adult years, and affect academic, social, and vocational outcomes (Champigny, Deotto, Westmacott, Dlamini, & Desrocher, 2020; Jacomb, Porter, Brunsdon, Mandalis, & Parry, 2018). For this reason, ongoing management of children and adolescents with ABI involves a multi-disciplinary team to address various domains of function and facilitate holistic rehabilitation (Lundine, Ciccia, & Brown, 2019) (Lundine, Ciccia, & Brown, 2019). Speech pathologists play a critical role in this team from the acute to chronic stages of injury and are primarily responsible for the assessment and management of cognition and communication (Lundine et al., 2019; Morgan et al., 2017).

Cognitive-communication Disorder in ABI

A history of childhood ABI puts adolescents at risk of disordered language and communication (Turkstra, Politis, & Forsyth, 2015). Approximately 75% of individuals with brain injury will experience some degree of impairment in social, communication, and/or language functions (MacDonald, 2017; Turkstra et al., 2015). Aphasia and motor speech disorders can result from childhood ABI, yet the most common clinical finding is a deficit in cognitive-communication (Laane & Cook, 2020), which is impairment in expressive and receptive language skills that results from cognitive dysfunction (Turkstra et al., 2015). Cognitive-communication disorders influence a range of language modalities such as oral and written expressive and receptive language and gesture, and one or multiple language domains, including phonology, morphology, syntax, or semantics, and more commonly, discourse and pragmatics (Laane & Cook, 2020; Turkstra et al., 2015).

The program of research presented in this thesis is focused on cognitive-communication deficits at the discourse-level. Discourse skills are critical for daily communication, so impairments in discourse skills are proposed to contribute greatly to social and academic problems, stress and burden for individuals and their families (Dipper & Pritchard, 2017; Hay & Moran, 2005). Literature related to discourse and its impairment following childhood ABI is reviewed in detail later in this chapter (page 16). Current clinical guidelines encourage speech pathologists to understand the functional, social, academic, and personal impact of cognitive-communication deficits, and the non-linguistic factors that influence the extent of impairment (College of Audiologists and Speech-Language Pathologists of Ontario, 2018; Morgan et al., 2017). This knowledge influences a clinician's approach to evidence-based assessment and intervention, and should be grounded in a theoretical model (Laane & Cook, 2020; Whyte, Gordon, Gonzalez, & Leslie, 2009).

A Model of Cognitive-Communication in ABI

Childhood ABI can impact a broad spectrum of domains of functioning that go on to influence communication skills (Laane & Cook, 2020). MacDonald's (2017) model of cognitive-communication competence (see Figure 1) identifies key factors across seven domains that should be considered throughout the clinical decision-making process.

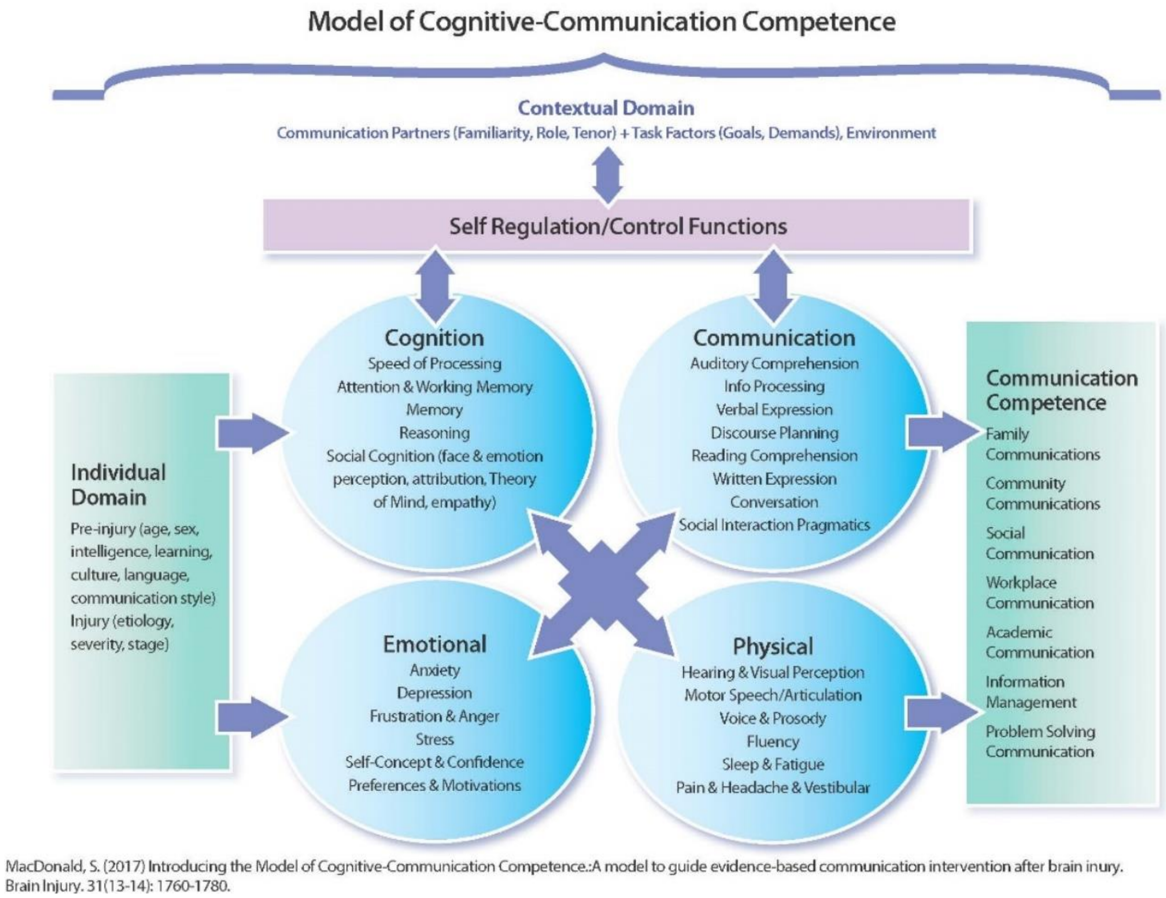

Figure 1. MacDonald's (2017) model of cognitive-communication[1].

[1] Please see copyright permission in Appendix B.

This model proposes seven critical domains to be considered in assessment and treatment planning, and general understanding of the impact of ABI on communication competence in this population. These domains are individual, context/environment, cognition, communication, emotion/psychosocial, physical, and communication competence.

The contextual domain considers the demands of the individual's daily communication environments (e.g. academic, social, vocational, personal) and the range of communication partners (MacDonald, 2017). This domain also includes task-related factors such as the context of assessment and intervention for cognitive-communication skills. The individual domain considers pre-injury factors such as age and gender, educational history, socioeconomic status, language and culture, as well as injury-related factors such as cause, severity, and location of injury (MacDonald, 2017). The cognitive domain includes disorders in cognitive function that result from ABI, particularly those proposed to influence language and communication post-injury. These include skills in executive function, attention, working memory, verbal memory, and learning (MacDonald, 2017). The emotional / psychosocial domain considers those psychological conditions that are common following ABI. These include stress, anxiety, and depression, as well as emotional regulation, self-confidence, and motivation. The physical domain covers the physical impairments caused by ABI. These include hearing and visual deficits, fatigue, and dizziness, as well as motor speech (e.g. dysarthria/dyspraxia) and voice or prosody conditions. The communication domain includes skills related to auditory, reading, and oral comprehension, written and verbal expression (i.e. discourse), and pragmatics (MacDonald, 2017). Finally, MacDonald's (2017) model emphasises that the goal of assessment and intervention for cognitive-communication is to profile and target communication competence in terms of family, social, and academic communications, among others.

This conceptualisation of cognitive-communication as a multi-faceted condition is consistent with the World Health Organisation's (WHO) International Classification of Functioning, Disability, and Health: Children and Youth Version (ICF-CY) (WHO, 2001). The ICF-CY enables the consideration of the impact of an ABI across domains of Body Structure and Function, Environment, and Activities and Participation. Like the ICF-CY, MacDonald's (2017) model delineates the impact of ABI (Health Condition) on cognitive, linguistic, and physical skills (Body Structure and Function), and how these impairments influence participation in activities involving communication and overall communicative competence (Activities and Participation), in light of contextual and demographic factors (Environmental and Personal Factors) (MacDonald, 2017; WHO, 2007).

MacDonald's (2017) model will guide the subsequent review of literature set out in this chapter across domains of function that are relevant to this thesis. This program of research relates to the cognitive and psychosocial correlates of spoken discourse in adolescents with ABI. As such, the following sections will review pertinent studies of function across cognitive, communication, and psychosocial domains in childhood ABI. The primary focus will be on discourse skills and discourse impairments in this population within the communication domain.

Impairments in the Cognitive Domain

Numerous studies have explored the cognitive sequelae of childhood ABI, given that those areas of the brain that house neural circuitry for multiple cognitive processes are particularly susceptible to damage (McAllister, 2011). The mechanics of traumatic ABIs, in particular, tend to include an initial compression of cortical tissue as well as rapid accelerating and decelerating movements (McKee & Daneshvar, 2015). The left and right frontal lobes are particularly susceptible to impairment given their position in the brain relative to the bony structures of the skull (McAllister, 2011). Deficits in cognitive function often occur following direct injury to the frontal lobes, but also via direct mechanisms of diffuse damage given the complexity of neural connections to other parts of the brain (Araki, Yokota, & Morita, 2017; Chan, Shum, Toulopoulou, & Chen, 2008; McKee & Daneshvar, 2015). Most often, deficits in executive function, attention, memory, and intellectual function have been implicated (Catroppa & Anderson, 2002; Levin & Hanten, 2005), which are also those proposed to underpin cognitive-communication disorders (Babikian & Asarnow, 2009).

Executive dysfunction. Up to 40% of children and adolescents who sustain an injury between five and 15 years of age present with deficits in executive function, which can persist into adulthood (Beauchamp & Anderson, 2013; Sesma, Slomine, Ding, & McCarthy, 2008). Executive function is a multifaceted and dynamic cognitive system that involves multiple higher-level and lower-level processes (Miyake et al., 2000). Miyake et al. (2000) propose three distinctive, yet interrelated sub-processes of shifting, inhibition, and updating in working memory. These processes function alongside working memory to facilitate voluntary, goal-oriented behaviours such as problem-solving, organisation, planning, and behavioural regulation (Miyake et al., 2000). This conceptualisation of executive function has been influential in studies of typical and atypical development of executive function, including studies of executive dysfunction following ABI (Loher & Roebers, 2013). Studies have documented impairments in higher-level executive processes, such as planning, organisation, and self-monitoring (Shanahan, McAllister, & Curtin, 2011), as well as distinct sub-processes of shifting, updating in working memory, inhibitory control (Konrad, Gauggel, Manz, & Schöll, 2000), and working memory capacity (Conklin, Salorio, & Slomine, 2008). Additional studies have identified associations between performance on standardised measures of executive function and impaired application of executive behaviours in real-world tasks such as schoolwork, chores, and social interaction (Gioia & Isquith, 2004).

Attention. Deficits in attention are another frequent sequelae of paediatric ABI (Ginstfeldt & Emanuelson, 2010). Attentional processes are required to control behaviour and neurocognitive functioning as they allow us to select and process meaningful environmental stimuli and control encoding and retrieval in memory (Königs et al., 2015). Reduced attentional capacity is common in the subacute phase of injury, and often persists throughout the chronic phase and into adulthood (Ginstfeldt & Emanuelson, 2010; Narad et al., 2018). Impairments in specific attention sub-types have been observed in children and adolescents with ABI including sustained attention (Pentland, Todd, & Anderson, 1998), selective attention (Park, Allen, Barney, Ringdahl, & Mayfield, 2009), and divided attention (Robertson & Schmitter-Edgecombe, 2017). Reduced attention span has also been identified (Park et al., 2009). Each of these impairments having the potential for a profound impact on social and academic participation and affect the success of rehabilitation (Ginsfeldt & Emanuelson, 2010).

Memory. Childhood brain injury is also known to affect encoding, storage, and retrieval of information from short and long-term memory (Babikian & Asarnow, 2009; Taylor et al., 2008). In the case of mild to moderate ABI, researchers have observed inconsistent defects in immediate and delayed retrieval of verbal and visual information that can persist over time (Brookshire, Chapman, Song, & Levin, 2000; Catroppa & Anderson, 2002). Deficits in verbal memory in childhood ABI are given particular focus in this thesis, which refer to the ability to encode and retrieve verbally presented information, and are related to learning and communication across the lifespan (Acheson & MacDonald, 2009; Tatsumi & Watanabe, 2009). In the case of severe injuries, verbal memory deficits can also persist and continue to deteriorate throughout adolescence and into adulthood (Anderson & Catroppa, 2006; Catroppa & Anderson, 2002). These impairments can also pose a significant barrier to successful re-integration into social and academic environments where the ability to encode, learn, and retrieve information, particularly verbally presented content, is a daily requirement (Morgan et al., 2017).

Intellectual function. Performance on measures of intelligence have been shown to remain largely intact following paediatric ABI (Crowe et al., 2012). Global intellectual abilities have been regarded as less vulnerable to damage following brain injury compared to executive function, memory, or attentional processes (Crowe et al., 2012). However, children and adolescents with more severe injuries have been shown to perform below their non-injured peers on measures of verbal and non-verbal IQ, despite still obtaining scores just within the average range (Babikian & Asarnow, 2009). Severe injuries sustained before the age of five years, however have been found to affect performance on IQ measures (Ewing-Cobbs et al., 2006). This reduction in performance on measures of IQ is believed to reflect reduced rate of cognitive development in learning and executive processes (Turkstra et al., 2015).

Impairments in the Communication Domain

Disorders of language and communication are a common consequence of childhood brain injury (Turkstra et al., 2015). While language deficits associated with aphasia can be observed in this population, deficits in higher-level cognitive-communication skills are more commonly documented (Laane & Cook, 2020). As previously mentioned, cognitive-communication disorders can manifest across domains of language in this population (Turkstra et al., 2015). For instance, in children and adolescents with early-acquired and/or more severe injuries, deficits have been observed in semantics and expressive vocabulary (Brookshire et al., 2000; Ewing-Cobbs & Barnes, 2002), verbal fluency (Brookshire et al., 2000), and sentence formulation (Hanten et al., 2009). Difficulties at the word and sentence level have been, however, infrequently observed following later-acquired or less severe injuries, which make up the majority of this clinical population (Turkstra et al., 2015; Sullivan & Riccio, 2010).

The hallmark cognitive-communication deficit following ABI is that of verbal pragmatic behaviour (Coelho, 2007; Lê, Mozeiko, & Coelho, 2011; Turkstra et al., 2015). Pragmatics refers to the appropriate use of language and communication skills in light of contextual rules and expectations (Cherney, 1998). Individuals with pragmatic impairments exhibit "behaviours which have the potential, if used inappropriately, to disrupt or penalize conversational interchanges" (Milton, Prutting, & Binder, 1984, p.1141) and are therefore reflected in difficulties in production of language at the discourse-level (Turkstra et al., 2015). The following section of this chapter will review literature and theory pertinent to discourse-level language and its impairment in this childhood ABI.

Discourse-level language. Discourse refers to the use of language to communicate effectively with others while integrating contextual and pragmatic demands of particular environments (Sullivan & Riccio, 2010). In the communication domain of MacDonald's (2017) model, discourse is reflected in items of 'Verbal Expression', 'Discourse Planning', and 'Conversation. In the ICF-CY, discourse skills are included at the level of Activity and Participation under items of 'Speaking' (d330), 'Conversation' (d350), and 'Discussion' (d355) (WHO, 2007). Competent discourse-level communication is imperative for participation in everyday life across formal and informal environments (Turkstra, 2000). Discourse deficits can, therefore, impose limitations and restrictions at this level in clinical populations (Coelho, 2007; MacDonald, 2017). For adolescents, the ability to express oneself appropriately at the discourse-level is a valuable skill involved in the formation and maintenance of relationships, participation in the home, school, and community, and identity development through self-expression (Nippold, 2005; Turkstra, 2000). For this reason, remediation of discourse is a clinical priority in language impaired populations, including ABI (Coelho, 2007; Dipper & Pritchard, 2017).

A model-based account of discourse production. Discourse is a complex process that involves the retrieval and integration of linguistic and contextual information (Frederiksen & Stemmer, 1993). Frederiksen and Stemmer's (1993) model presents discourse as a stratified multi-level process that draws on multiple domains of language. In this model, discourse production starts with a conceptual representation of the structure of the communication goal (schema generation). This schematic framework guides the retrieval of accurate information from memory (insertion of semantic information), which is then prioritised for relevance and importance (selection and prioritisation of information), and sequenced according to the schematic frame (generation, selection, and chunking of propositions). Following this, the content undergoes phonological and morpho-syntactic encoding (linguistic formulation), before it is eventually articulated (articulation).

Frederiksen and Stemmer's (1993) model suggests discourse production involves the integration of multiple linguistic skills; some of which involve higher-level language and cognition. In line with this model, Jakobson (1980) encourages consideration of both "the totality and the interrelation between the different parts of the totality have to be taken into account" (p. 95) to understand an array of strengths and weaknesses in discourse. As such, the stages and stores of information involved in discourse production provides the basis for selection of outcome variables with which discourse features can be analysed (Jakobson, 1980). There are numerous discourse outcome measures available in the discourse literature. In an effort to enhance consistency in discourse analysis, Coelho (2007) categorises word to whole-text language features of discourse in a way that is congruent with Frederiksen and Stemmer's (1993) model. Discourse features are grouped according to whether they are micro- (within-sentence, e.g., productivity, syntactic complexity), micro-structural (across-sentence, e.g., analyses of cohesion), macro-structural (between-sentence, e.g., coherence), or super-structural features (whole-text, e.g., story grammar) (Coelho 2007).

Discourse genres in adolescence. In Frederiksen and Stemmer's (1993) model, the selection and organisation of linguistic information is guided by the specific content and structure of discourse, which relates to the purpose of communication (Dipper & Pritchard, 2017). In considering the impact of ABI on discourse, it is therefore important to consider the different forms of discourse required by daily interaction across formal and informal environments (Coelho, 2007). Different forms of discourse are referred to as 'genre', and can be broadly classified into dialogic and monologic discourse (Coelho, 2007; Dipper & Pritchard, 2017). Dialogic discourse refers to interactive discourse, such as conversation, where communication partners engage in interactive coordination and sequential organisation of language content (Dipper & Pritchard, 2017; Lê et al., 2011). In contrast, monologic discourse refers to that which does not involve reciprocal exchange of verbal output, or require the same pace and maintenance of interaction as conversation (Levinson & Torreira, 2015). Monologic discourse does require, however, a communication partner and therefore the speaker is required to read social context and judge listener knowledge through non-verbal cues (Body, Perkins, & McDonald, 1999; Cassell, Nakano, Bickmore, Sidner, & Rich, 2001;Westby, 1985). Monologic discourse is the focus of this thesis, given it comes in multiple forms and is important for psychosocial wellbeing and success across social and academic environments regularly encountered by adolescents (Lê et al., 2011).

Communication in childhood and adolescence necessitates a range of monologic discourse genres (Turkstra, 2000). Children frequently produce personal and fictional narratives, informative expository, and persuasive texts for academic and social purposes (Nippold, Mansfield, Billow, & Tomblin, 2008). Personal narratives involve a recount of a real past experience, while a fictional narrative is either a composition or a recall of a previously heard or read story (McCabe, Bliss, Barra, & Bennett, 2008). Expository discourse refers to the use of language to describe fact-based information about a topic or concept, while persuasive discourse aims to convince the communication partner to share a specific point of view (Nippold, 2010).

These genres can be further grouped into event-centred (personal recount and fictional narrative) and topic-centred (expository and persuasive) genres (Berman & Nir-Sagiv, 2007). This distinction is an important consideration for researchers and clinicians given the proposed differences in processing requirements and cognitive and linguistic demands, and the implications of this for assessment and treatment (Berman & Nir-Sagiv, 2007). Event-centred genres are associated with bottom-up processing as speakers organise and produce content in a step-by step manner facilitated by learned narrative schema (Berman, 1995). Topic-centred genres are associated with top-down processing, where speakers retrieve and elaborate on concepts within a general topic, which are linked according to temporal, logical, adversative, or causal relationships (Berman & Nir-Sagiv, 2007). Event-centred genres are early-developing, and the information and structure of these texts is largely consolidated in childhood (Berman & Nir-Sagiv, 2007; McCabe et al., 2008). Conversely, topic-centred discourse is regarded as more cognitively and linguistically demanding as it occurs later in the oral to literate continuum and academic curriculum, and continues to consolidate throughout adolescence (Nippold, 2007; Westby, 2014). As children age, greater expectations are placed on the individual to competently produce both event-centred and topic-centred texts for academic and social purposes (Turkstra, 2000). Furthermore, adolescents are expected to demonstrate more advanced linguistic and structural features within their discourse as they age (Nippold, 1998). This has been demonstrated by longitudinal research that documents continued development in lexical diversity and the use of longer and more complex syntax between childhood, adolescence, and adulthood in the context of narrative and expository discourse (Channell, McDuffie, Bullard, & Abbeduto, 2015; Heilmann, Nockerts, & Miller, 2010; Nippold, Mansfield, & Billow, 2007; Nippold, Frantz-Kaspar, Cramond, Kirk, Hayward-Mayhew, & Mackinnon, 2013; Westerveld & Moran, 2011).

Discourse skills following childhood ABI. A number of studies have previously investigated event- and topic-centred monologic discourse skills following paediatric ABI. The majority of this research has explored deficits in event-centred, narrative skills (Aguilar et al., 2019; Chapman, 1997; Chapman et al., 1992; Chapman et al., 2006; Chapman, Levin, Wanek, Weyrauch, & Kufera, 1998; Chapman et al., 2001; Ewing-Cobbs, 1998; Walz, Yeates, Taylor, Stancin, & Wade, 2012), while others have examined skills in topic-centred, expository and persuasive tasks (Hay & Moran, 2005; Lundine, 2019; Lundine & Barron, 2019; Moran, Kirk, & Powell, 2012). In terms of measurement, most studies have employed variables related to measure micro-linguistic to super-structural features. Existing studies generally categorise micro-linguistic and micro-structural variables within a ‘language / linguistic domain’ (e.g., total number of words, total number of T-units, lexical diversity, measure of sentential and grammatical complexity, and cohesion (Ewing-Cobbs et al., 1998; Hay & Moran, 2005), and macro-structural to super-structural features within an ‘information domain’ (e.g., analysis of propositions, or units of meaning, story, or episodic structure and global story content, or gist), or the ‘organisation/flow of information’ (Chapman et al., 1992; 1997; 1998; 2001; Hay & Moran, 2005; Moran et al., 2012).

In the context of event-centred discourse, studies have documented particular impairment in macro-structural and super-structural features (Biddle, McCabe, & Bliss, 1996; Chapman, 1997; Chapman et al., 1992; Chapman et al., 2006; Chapman, Levin, Matejka, Harward, & Kufera, 1995; Chapman et al., 1998; Chapman et al., 2001; Ewing-Cobbs, 1998; Hay & Moran, 2005; Moran et al., 2012). Chapman et al (1992) used a narrative retell task to examine discourse in 20 children and adolescents between 9 and 18 years of age with a history of mild/moderate or severe ABI. The authors observed consistent deficits in macro and super-structural features such as the under-production of critical information and poor organisation of narrative structure. Conversely, few deficits in micro-linguistic features were observed (Chapman et al., 1992). Similar results have also been documented in studies of narrative retells (Aguilar et al., 2019; Chapman et al., 1997; Walz et al., 2012), and personal and current event narratives (Van Leer, 1999). These deficits have also been recorded in persuasive (Moran et al, 2012) and expository tasks (Hay & Moran, 2005), suggesting an influence on topic-centred discourse skills.

Studies have, however, observed impairments in micro-linguistic and micro-structural features in this population. For example, Chapman et al. (1992) observed shorter discourse samples in children and adolescents with severe ABI. Later, Ewing-Cobbs et al. (1998) found 17 children with moderate to severe ABI produced shorter discourse, fewer different words (micro-linguistic), and fewer complete, and accurate, cohesive ties (micro-structural) alongside consistent deficits in macro- and super-structural features (Ewing-Cobbs et al., 1998). More recently, Walz et al. (2012) examined the effects of moderate and severe ABI on narrative retell skills in 62 children at 18 months post-injury. In comparison to children without brain injury, participants with moderate to severe TBI showed a reduction in the amount of language produced (micro-linguistic) and less expression of relevant story information and central semantic meaning (macro-structural). Using the same retell task, Aguilar et al. (2019) also observed few differences in micro-linguistic features for children and adolescents with moderate injuries, yet those with severe ABI were less productive than those with moderate injuries and non-injured peers. Similar results have been observed in expository discourse where Hay and Moran (2005) found reduced productivity and syntactic complexity in nine children and adolescents with ABI collapsed across narrative and expository retell texts.

Discourse skills in paediatric ABI have also been examined in the context of gist production and summarisation skills (Chapman et al., 2004; 2006; Lundine et al., 2017). Summary production involves integration of information to develop a generalised understanding of central meaning, which has been linked to learning in paediatric populations (Chapman et al., 2006). Chapman et al. (2004) compared narrative summarisation skills of 23 children with history of severe ABI with age-matched controls. The children with ABI were less able to integrate information and produce relevant information. These results were consistent with those of Chapman et al. (2006), who found less cohesive and coherent narrative summaries in children and adolescents with severe ABI. This work was recently extended by Lundine et al. (2019) in their study of the quality of expository and narrative summaries produced by adolescents with ABI, which were found to be of poorer quality across word to whole-text language features .

Overall, current evidence indicates children and adolescents with a history of ABI “talk better than they communicate” (Holland, 1982, p.223), which may have ongoing implications for social and academic success post-injury (Coelho, 2007).

Impairments in the Psychosocial Domain

Childhood ABI places an individual at increased risk of psychosocial impairments that can persist throughout adolescence and into adulthood (Anderson, Brown, Newitt, & Hoile, 2009; McCarthy et al., 2005). Researchers have described a range of issues within this population, including post-traumatic stress disorder, anxiety and depression, low self-esteem and self-confidence, grief and emotional lability (Anderson et al., 2009). These difficulties contribute to antisocial behaviour, social disengagement, and fewer meaningful relationships as well as reduced academic and vocational success (Anderson et al., 2009; Emery et al., 2016) and, ultimately, can contribute to significant reductions in quality of life into adulthood (Ryan et al., 2019). Of particular interest in this thesis, are those studies that have examined the influence of childhood ABI on social and academic participation, family functioning, and health-related quality of life (HRQoL).

Participation. The impact of ABI on the quality and quantity of daily participation is a critical consideration for speech pathologists (Dumas, Bedell, & Shannon Hamill, 2003; MacDonald, 2017). Within a social context, children and adolescents with ABI have reported more maladaptive and antisocial behaviour, and described themselves as less socially competent than their peers, leading to directly influencing their involvement in daily social interaction (Anderson et al., 2009; Ganesalingam et al., 2011). Studies have documented a significant impact of childhood ABI on the quantity and quality of participation in the home, school, and community using the Child and Adolescent Scale of Participation (CASP) (Bedell, 2004; Bedell, Haley, Coster, & Smith, 2009; Bedell & Dumas, 2004). In particular, researchers have found considerable restrictions to daily participation in social and structured activities within the school and community environments for children and adolescents with moderate to severe ABI (Galvin, Froude, & McAleer, 2010).

Insight into the factors influencing experienced by children and adolescents with moderate to severe ABI, particularly participation restrictions in adolescents with ABI have also been explored. Mealings and Douglas (2010) found adolescents with ABI felt restricted due to difficulties related to socialisation and in relationships within the school environment; expressing that "life without social interaction and activity was boring" (p.7). The impact of paediatric ABI on social participation and friendships, specifically, has received direct attention. Bohnert, Parker, and Warschausky (1997) found children with severe ABI reported high levels of conflict and less personal friendships relative to those without ABI. In a similar study, Yeates et al. (2013) found the majority of their participants with ABI were rated as less sociable and had fewer friendships than their non-injured peers. More recently, Heverly-Fitt et al. (2014) compared ratings of friendship quality between children and adolescents with, and without, brain injury. The ability to make, and maintain, friendships was reported as a key protective factor against poor psychosocial outcomes such as internalising and externalising problems (Heverly-Fitt et al., 2014).

Family functioning. There is consistent evidence to support an increased risk of family dysfunction following childhood ABI (Gan & Schuller, 2002; Winstanley, Simpson, Tate, & Myles, 2006). Cohesiveness within the family unit has been identified as a protective factor for social competence and general functional and psychosocial outcomes following paediatric ABI (Rivara et al., 1996). Wade et al.

(2002) observed reduced family functioning in children and adolescents with moderate to severe ABI, with greater severity associated with further deterioration in family function over time. Mild injuries have also been related to negative family outcomes. Ganesalingam et al. (2008) documented persistent reductions in family function, and increases in family burden, following mild concussive brain injuries.

Health-related quality of life. HRQoL refers to the overall impact of a physical or mental illness on physical functioning, emotional functioning, and social and community participation (Erickson, Montague, & Gerstle, 2010). Studies have documented considerable reductions in self- and parent-reported HRQoL following paediatric ABI (Erickson et al., 2010; Horneman, Folkesson, Sintonen, von Wendt, & Emanuelson, 2005; Stancin et al., 2002). Stancin et al. (2002) was the first to examine self-reported ratings of HRQoL in adolescents with mild to severe injuries. Participants rated similar HRQoL across the three severity groups, except for behavioural HRQoL, in which severe ABI participants reported the lowest ratings relative to other participants with mild to moderate ABI, and those without head injury. These findings have been replicated by Erickson et al. (2010), who found significantly reduced HRQoL, particularly in relation to psychosocial outcomes in the school environment. Reduced HRQoL has also been observed in adults with a history of childhood injury (Horneman et al., 2005).

Associations between Cognitive, Psychosocial, and Communication Domains

The literature discussed thus far has described deficits across cognition, communication, and psychosocial domains that are prevalent in childhood ABI. According to Togher et al. (2014) speech pathologists who work in the field of ABI are expected to have "essential clinical knowledge" (p.358) of the relationship between deficits in cognition and communication. Clinicians' knowledge is also expected to extend to the everyday functional impact of communication deficits (Katz & Kennedy, 2002). This is consistent with the bidirectional arrows between cognition, communication, and psychosocial outcomes in MacDonald's (2017) model (see Figure 1). This model provides a theoretical foundation to consider the relationship between domains of function at each stage of the clinical decision-making process. Furthermore, an understanding of the underlying cognitive mechanisms, and real-world psychosocial impacts, of disordered discourse is imperative for ongoing development of rehabilitative interventions (Turkstra, Norman, Whyte, Dijkers, & Hart, 2016; Whyte, 2014; Whyte et al., 2009). The following sections of this chapter will review the literature that has examined associations between discourse and cognitive and psychosocial outcomes in this population.

Cognitive function and discourse skills. MacDonald's (2017) model depicts a clear link between the cognitive domain and discourse-level communication skills, which supports the notion that discourse lies "at the crossroads of language and cognition" (Lê et al., 2011, p.19). Consequently, an awareness of the impact of disordered cognition on language and communication may be considered critical for clinical decision-making in the area of ABI (Togher et al., 2014). Brain-imaging studies have shed light on the cortical areas, and associated processes, involved in discourse planning. Mar (2004) described considerable activation of the prefrontal cortex, posterior cingulate, and anterior and temporo-parietal areas of the brain during discourse production in adults with no history of ABI (Mar, 2004). These areas of the brain that are linked to discourse are particularly vulnerable to damage in ABI, which supports a cognitive basis to disordered discourse in paediatric brain injury (McAllister, 2011).

Cognitive function and discourse skills in childhood ABI. Proposed associations between deficits in cognition and discourse have been explored in a number of studies of adult ABI (Coelho, Lê, Mozeiko, Krueger, & Grafman, 2012; Marini et al., 2011; Marini, Zettin, & Galetto, 2014; Matsuoka, 2012). In contrast, only a handful of studies have examined the cognitive correlates of discourse in the paediatric population. In an early study, Dennis and Barnes (1990) examined relationships between higher-level language, verbal intelligence, and working memory in 33 children and adolescents with history of ABI. Higher-level language was assessed using subtests of the Test of Language Competence – Expanded (TLC-E; Wiig & Secord, 1989) that assessed sentence formulation, interpretation of lexical and semantic ambiguity, and inference generation (Wiig & Secord, 1989). General performance on the TLC-E was related to measures of verbal IQ, and inference generation, specifically, was related to working memory. While this provided early evidence of a link between deficits in higher-level language and cognition in this population, subsequent studies have rendered inconsistent results. For instance, Chapman et al. (1992) observed no relationship between verbal memory and narrative retell skills in children with ABI. Similarly, Moran et al. (2012) found no relationship between working memory and features of persuasive discourse in adolescents with ABI. In contrast, Chapman, Levin, Matejka, Harwarrd, and Kufera (1995) explored the link between discourse macro-structure, planning, and the application of organisational schemata. The authors hypothesised a relationship between these cognitive functions and the retrieval and organisation of narrative schemata and relevant content (Chapman et al., 1995). Hypotheses of a relationship between these cognitive processes and organisation and content were partially supported. Reduced skills in planning and application of organisational schemata were significantly related to difficulties in narrative macro-structure. This suggests that higher-level executive processes are responsible for mediating the structural organisation of discourse-level language.

The relationship between discourse skills and executive function, processing speed, and declarative memory were further examined by Brookshire et al. (2000) in their study of 91 children with mild and severe ABI. Adjusting for general verbal functioning, the study documented significant relationships between longer discourse and more complex sentence structures and higher scores on measures of executive function and verbal fluency. Executive function was also related to the presence of essential narrative components, gist propositions, and adequate episodic structure (Brookshire et al., 2000). Similarly, Hay and Moran (2005) observed significant relationships between working memory and micro-linguistic to super-structural features collapsed across narrative and expository retell tasks. Better working memory was correlated with enhanced performance across all micro-linguistic to super-structural measures, with the exception of syntactic complexity, indicating a relationship between cognitive deficits and productivity, total propositions, and episodic structure. Researchers have also documented a link between better updating in working memory and the ability to better integrate information in narrative summaries following paediatric ABI (Chapman et al., 2006).

The literature contributes to an emerging understanding of the cognitive correlates of discourse skills in paediatric ABI, although the majority of studies have examined these in narrative discourse alone. According to Westby (2014), discourse genres are considered more or less complex on the basis of their cognitive-linguistic demands and age of acquisition on the oral to literate continuum. In particular, narratives may not place sufficient demands on cognitive resources to reveal the range of strengths and weaknesses in discourse, particularly in adolescence (Hay & Moran, 2005; Moran et al., 2012). This means our understanding of the cognitive basis of poor discourse may be limited, as few studies have explored the correlates of a range of genres relevant to social and academic contexts (Coelho, 2007; Katz et al., 2002). In response, one of the aims of this thesis is to explore the cognitive correlates of discourse in adolescents with ABI across a range of monologic discourse genres. In the context of a limited evidence base, researchers and clinicians may consult theoretical frameworks to understand the relationship between cognitive and discourse impairments in speakers with ABI (Coelho et al., 2013).

A model-based account of links between cognition and discourse. The Structure Building Framework (SBF), a model of discourse processing, was designed to account for the cognitive mechanisms involved in discourse processing in populations without language or communication deficit (Gernsbacher, 1990). The model has also been validated in examining cognitive functions involved in written discourse production in typical adult populations, as well as disorders of spoken discourse adults with ABI (Coelho et al., 2013; Lê, Coelho, Mozeiko, Krueger, & Grafman, 2012). There is, therefore, support for use of this model in paediatric ABI, yet there has been no investigation of the SBF in this population.

The SBF is founded upon the notion that we comprehend incoming discourse by building coherent mental representations of content. These structures are formed by retrieving and sequencing memory stores activated by incoming information (Gernsbacher, 1990). Once these memory nodes have been retrieved, three processes take place to plan, organise, and sequence the mental structure of incoming discourse. These are: (1) laying a foundation, (2) mapping relevant content, and (3) shifting to initiate a new episode. Essentially, we activate and retrieve stored representations of the structures of the genre that coheres with incoming information. This forms the foundation for the mental representation of discourse. Information that has been activated in memory is then mapped onto this representation. Prior to this, the information is temporarily held in working memory while it is judged for relevance (St Clair-Thompson & Gathercole, 2006). When the incoming content is not related to the previously heard information, we draw on our ability to shift to create a new substructure, like a new episode in narrative. Two additional cognitive processes are involved in the retrieval of appropriate narrative structure and content. These are suppression and enhancement. Content in memory is enhanced if it is necessary for the current, or subsequent, substructures (episodes) of discourse. When content in memory is no longer, or less relevant, it is suppressed. Suppression mechanisms are also involved in shifting to a new substructure when required, such as that which occurs when moving onto a new episode in narrative (Gernsbacher, 1990).

Although the SBF was designed to account for discourse comprehension, researchers have applied this framework to account for deficits in discourse production impairments in adults with ABI. Lê et al. (2011) likened the retrieval and sequencing of narrative schema, or episode structure, to laying a foundation. Information that is relevant to that episode is activated and enhanced in memory and mapped onto the current episode, while information that may be relevant in the future is held in working memory, or suppressed to signal a shift to a new episode. This process implicates executive, memory, and attentional skills, which are common deficits in paediatric ABI (Babikian & Asarnow, 2009). Discourse and psychosocial health in ABI.

Discourse skills and psychosocial health in childhood ABI. Research has established long-term implications of poor social skills for wellbeing and participation in paediatric ABI (Parker, Rubin, Erath, Wojslawowicz, & Buskirk, 2006). In a recent qualitative study, adolescents with ABI expressed feelings of embarrassment, as well as a loss of identity and sense of belonging as a result of their difficulties in expressive communication (Buckeridge, Clarke, & Sellers, 2020)). Despite this, few studies have explored the specific role of discourse skills in understanding psychosocial outcomes. Yeates et al. (2004) examined the bases of reduced social outcome in 189 older children and adolescents with ABI, by exploring the relationship between poor cognition and psychosocial outcomes. The TLC-E (Wiig & Secord, 1989) was included as a measure of social-cognitive skills together with measures of executive function. Psychosocial outcomes were assessed using the socialisation scale from the Vineland Adaptive Behaviour Scales (VABS) (Sparrow, Balla, & Cicchetti, 1984), and Social Competence and Social Problems subscales of the Child Behaviour Checklist (Achenbach, 1991). Performance on the TLC-E predicted social integration, independent of executive function, indicating a potential role of higher-level language in psychosocial outcomes. Chapman et al. (1995) explored the link between macro-structural and super-structural narrative features and adaptive behaviour across domains of socialisation, communication, motor function, and daily living using the VABS. Discourse skills were correlated with the VABS communication scale, but no other associations were observed. Recently, Aguilar et al. (2019) explored the link between micro-linguistic and macro-structural discourse features, psychosocial health, and everyday functioning. Deficits in micro-linguistic features were associated with poorer everyday functioning, and deficits in macro-structural features were associated with poorer psychosocial outcomes (Aguilar et al., 2019).

The results of these studies provide a preliminary understanding of the relationship between discourse and psychosocial outcomes in this population as is theorised in MacDonald's (2017) model the ICF-CY (WHO, 2007). Studies of the link between discourse and psychosocial outcomes have also used predominantly standardised tests and narrative discourse tasks. To my knowledge, no study has explored how psychosocial outcomes relate to competence in other genres required for social and academic participation. For example, in the context of adult ABI Galski et al. (1998) observed that higher ratings of social integration and quality of life were associated to more intact micro-linguistic to super-structural discourse features across procedural and narrative discourse. Recently, Elbourn et al. (2019) observed that up to 12-months following ABI, more accurate and complete narratives predicted better psychosocial outcomes across work and leisure, interpersonal relationships, and daily independence. This provides support for the potential psychosocial benefits of targeting discourse skills in paediatric ABI (Elbourn et al., 2019).

Recommendations for a Biopsychosocial Approach to Clinical Practice

With increasing attention paid to the long-term neuropsychological and psychosocial sequelae of paediatric ABI, speech pathologists are encouraged to support recovery beyond specific language deficits alone (Anderson et al., 2012; McCarron, Watson, & Gracey, 2019; Turkstra et al., 2015). The relationship between cognitive, communication, and psychosocial domains as it is illustrated in MacDonald's (2017) model is a critical consideration in clinical practice, particularly the real-world functional impact of communication impairment (Morgan et al., 2017). In a recent UK-based study, McCarron et al. (2019) explored the rehabilitation goals of 98 children and adolescents with a history of ABI, as they related to the domains of the ICF-CY (WHO, 2007). The majority of goals were identified at the level of Activity and Participation. Almost all participants had goals relating specifically to peer and family relationship, and participation in the classroom and community (McCarron et al., 2019). This is likely reflected in the current clinical practice of speech pathologists whose clients may want to "develop their potential, work productively and creatively, build strong and positive relationships with others, and contribute to their community" (Foresight Mental Capital and Wellbeing Project, 2008). Cognitive-communication deficits, particularly those in discourse, can be a considerable barrier to these goals, making them a salient assessment and intervention target in speech pathology[2] (MacDonald, 2017; Turkstra et al., 2015). Currently, however, there is limited literature available to guide assessment and treatment planning for cognitive-communication in paediatric ABI, particularly at the discourse-level (Morgan et al., 2017; Turkstra et al., 2015). This may impede evidence based clinical practice in this population, although current practice patterns for discourse in paediatric ABI have undergone limited exploration, particularly for intervention (MacDonald, 2017; Morgan et al., 2017).

The State of Clinical Practice for Discourse in Paediatric ABI

The translation of empirical research into clinical practice is a well-established issue in paediatric rehabilitation (Curran, Grimshaw, Hayden, & Campbell, 2011). To date, two studies have explored clinical practice of speech pathologists for cognitive-communication deficits in paediatric ABI, both with a focus on assessment only (Frank, Williams, & Butler, 1997; Frith, 2014). In their US-based study, Frank et al. (1997) surveyed over 200 clinicians across a range of clinical contexts including acute and outpatient rehabilitation, schools, and private practice. Respondents were asked to select the five most frequently administered assessments in clinical practice from a list of formal, standardised tasks. The authors observed no one preferred tool for assessment of cognitive-communication deficits in this population. The most popular tasks were those sensitive to expressive and receptive word and sentence-level skills such as the Peabody Picture Vocabulary Test

[2] Literature regarding current recommendations for discourse assessment and intervention is described in more detail in Chapter 3 (Study 2) of this research program.

(Dunn & Dunn, 2007) and the Clinical Evaluation of Language Fundamentals - Revised (Semel, Wiig, & Secord, 1987). This study also reported the use of informal assessment measures, but did not elaborate on specific tasks and outcome measures.

Later, Frith (2014) surveyed assessment practices for cognitive-communication deficits, including discourse, in paediatric ABI, delayed language impairment, and adult ABI. Consistent with Frank et al. (1997), the majority of clinicians reported a preference for standardised tests, and a lack of awareness as to available assessment tools, particularly for discourse, which was infrequently assessed. The preferred method of discourse assessment was informal observation of conversation, following which no analysis was undertaken. Consistent with current literature, narrative and procedural genres were assessed less frequently than conversational discourse, but more regularly than complex genres of exposition or persuasion (Frith, 2014). These topic-centred tasks were, indeed, never likely to be assessed in paediatric ABI, despite their relevance to academic participation in this age group. Further, survey participants expressed discomfort and uncertainty as to the availability and administration of discourse assessment and how these impacted on clinical practice. A more in-depth exploration of discourse assessment practice is warranted given previous studies have not explored the specific outcome variables and tasks used to detect impaired discourse micro-linguistic to super-structural features in this population in the context of variable and limited literature (Steel & Togher, 2019; Turkstra et al., 2015). As with assessment, the lack of evidence-based interventions may induce inconsistency in clinical practice, or deter clinicians from targeting discourse-level language in assessment and intervention (MacDonald & Wiseman-Hakes, 2010), yet there has been no exploration of current treatment practices for discourse in this population.

Summary of Literature

Cognitive-communication deficits are a common consequence of childhood ABI. These particularly impact an individual in their discourse-level language, which children and adolescents use to communicate for a range of social and academic purposes across formal and informal environments (Turkstra, 2000). For this reason, discourse assessment is considered ‘gold-standard’ in clinical populations, and clinicians are encouraged to incorporate discourse-level targets in intervention (CASLPO, 2018; Coelho, 2007; Heilmann et al., 2010; Morgan et al., 2017).

Cognitive-communication deficits, including those at the discourse-level, are underpinned by impaired cognitive function, and are proposed to relate to reduced psychosocial wellbeing (Laane & Cook, 2020; MacDonald, 2017; Turkstra et al., 2015). The link between discourse, cognition, and psychosocial in paediatric ABI remains unclear. Greater attention to the nature and extent of these relationships is critical for assessment and treatment planning in clinical practice, and ongoing treatment efficacy research (MacDonald, 2017; Turkstra et al., 2016; Whyte et al., 2009). This is a priority given the current paucity of literature to support evidence-based intervention, and limited awareness of how clinicians currently manage discourse in this population (Laane & Cook, 2020).

The Current Research Program

In response to the current literature, the overarching aim of this doctoral research is to expand our understanding of deficits in spoken discourse in adolescents with ABI, their clinical management, and how they relate to cognitive and psychosocial factors. This research program concentrates specifically on cognitive-communication deficits at the discourse-level experienced by adolescents with a history of childhood ABI. While the WHO defines adolescence as the period between 10 and 19 years of age (WHO, 1989), this research focuses on adolescents with ABI between 12 and 15 years of age. As per the Australian Curriculum, Assessment, and Reporting Authority (ACARA), this represents the age at which Australian students transition out of primary school and into secondary school (ACARA, 2010). The transition to secondary school corresponds with transition from childhood to early adolescence; a time fraught with social, emotional, and academic change (Evans, Borriello, & Field, 2018). As a result, this transition is regarded as one of the most stressful events in a young individual's life, and for some, it contributes to reduced psychosocial health and academic success (Evans et al., 2018). This stage of education can be significantly more challenging for adolescents with a history of ABI, who frequently fail to acquire and develop new skills at the same rate as their peers (Anderson & Catroppa, 2006). These adolescents do not acquire the cognitive-linguistic abilities that enable successful participation in increasingly challenging academic and social environments (Chapman, Max, Gamino, McGlothlin, & Cliff, 2003; McCarron et al., 2019). Consequently, increased supports are required from family, friends, and the community (McCarron et al., 2019). Speech pathologists play a particularly critical role in the remediation and/or compensation for communication difficulties experienced by adolescents with ABI to promote successful participation during these critical years and into adulthood (Lundine et al., 2019; McCarron et al., 2019). As a result, enhancing our understanding of the discourse-level deficits experienced by adolescents with ABI is a priority for ongoing research.

Chapter 2

The Relationship between Discourse and Cognitive Deficits in Speakers with ABI: A Systematic Review

Chapter Overview

This chapter presents the accepted manuscript of a published systematic review of the literature that explored relationships between cognitive and discourse deficits in speakers with ABI. As discussed in Chapter 1, MacDonald's (2017) model proposes a direct link between cognition and communication domains of function in speakers with ABI and exploratory research into the cognitive mechanisms that underpin communication impairments is critical for clinical practice and ongoing treatment research (Morgan et al., 2019; Whyte et al., 2009). The exact nature of this relationship remains unclear, as current literature in ABI is limited and methodologically diverse, particularly for paediatric brain injury. This has implications for evidence-based practice in this population (Coelho, 2007; MacDonald, 2017). This systematic review examines the existing literature to describe what is currently known of the relationship between cognitive deficits and disordered discourse following ABI. This encompasses a discussion of these links in light of Gernsbacher's (1990) SBF (see page 23), in order to identify the cognitive functions and variables of interest in subsequent empirical studies of this thesis.

The current study (Study 1) synthesises the results of past empirical studies as they relate to broader literature and theoretical models of discourse planning in order to identify gaps that may influence future research and clinical practice. This chapter presents an Accepted Manuscript version[3] of an article entitled, '*Discourse and cognition in speakers with acquired brain injury (ABI): A systematic review',* published by John Wiley & Sons publications in the International Journal of Language and Communication Disorders on 28/05/2018, available online: https://onlinelibrary.wiley.com/doi/10.1111/1460-6984.12394. The formatting of this study (headings, tables, etc) has been adapted to align with the larger thesis document. As this is an Accepted Manuscript, there is some repetition of key literature and theory that has been previously reviewed, although every attempt has been made to minimise this.

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[3] Copyright permission letters of approval are provided in Appendix C

Abstract

Background: Cognitive impairment, particularly of executive functioning, has been implicated in deficits in spoken discourse production following acquired brain injury (ABI). However, due to variation in the methodologies and heterogeneity of findings across studies, the nature and extent of this association is not well understood.

Method: This review aims to synthesise the literature investigating associations between cognitive deficits and discourse impairment after ABI. The review is reported in accordance with guidelines of The Preferred Reporting Items of Systematic Reviews and Meta-Analyses. Searches were conducted of a variety of databases including Medline, PsycINFO, EMBASE, CINAHL, ProQuest, Cochrane, and ERIC. Additional studies were identified via reference harvesting. Studies were included if they reported data on participants with ABI, assessed spoken discourse production and cognitive function, and performed statistical analyses to determine the association between discourse and cognitive variables. This review excluded non-English sources and those not published in peer-reviewed journals. Meta-analyses were not conducted due to variability across tools and terminology used to describe participant injury- and non-injury-related characteristics and outcomes.

Results: Twenty-five observational studies were included in the review. Findings revealed significant associations between multiple cognitive functions and discourse across micro-linguistic to super-structural measures. Methodological and terminological inconsistencies were identified across studies, which limited systematic comparison of results.

Conclusions: This review revealed present, yet heterogeneous, relationships between cognitive and discourse deficits in speakers with ABI. Associations were interpreted in light of a well-established model of discourse processing. Greater comparison across studies would have been facilitated by a standard nomenclature in relation to cognitive constructs and standardised discourse assessment. Future research should explore the influence of injury- and participant-related factors on discourse-cognitive relationships. The lack of information on conversational discourse and paediatric ABI limits the generalisability of this review to daily interaction following ABI. While applicable across the lifespan, in-depth investigation of discourse following ABI in childhood and adolescence is a priority due to complex changes in language and cognition, and the potential for impairments

profoundly impact social, emotional, and academic progression into adulthood. Given the centrality of remediating cognitive-communication difficulties in ABI, the interrelationships between discourse and cognition should retain a critical focus of research. This will inform clinical management and future research with this population. Findings have implications for our theoretical understanding of discourse and the nature of its breakdown in ABI. This review is registered by PROSPERO (CRD42016051571).

Introduction

Advancements in medical management following acquired brain injury (ABI) have resulted in an increasing number of individuals living with persistent cognitive and linguistic deficits. ABI frequently results in long-term difficulty in the production of spoken discourse, which has direct consequences for social interaction. In the absence of aphasia, these difficulties are referred to as cognitive-communication deficits, and have been observed across the full range of communicative contexts. Deficits have been observed in the clinically elicited monologic contexts of narrative and procedural discourse, as well as in the dialogic conversational discourse of everyday communication. Whilst these genres differ in their structure and pragmatic requirements, discourse deficits broadly manifest in the presence of word-level errors and disorganised output at the sentence- and whole-text level. The nature and extent of these impairments often become apparent when transitioning into increasingly complex academic and social environments, or returning to vocational, domestic, and community roles that require competency over a range of discourse types, or genres (Chapman et al., 2010). These transition periods are a focus for clinicians whose aim is to assist in maximising the reintegration of people with ABI into previous or new roles in society.

The prioritisation of discourse as a target in speech pathology intervention is reflected in the guidelines approved by Australia's National Health and Medical Research Council regarding the management of communication disorders following ABI (Morgan et al., 2017). Attention has focused on exploring the nature and extent of these difficulties, with the view to developing efficacious treatment methods (Galski, 1998; Galvin et al., 2010). As cognitive-communication deficits arise from cognitive impairments following ABI, it is not surprising that treatment methods targeting cognitive and discourse skills independently have had limited success (Cannizzaro & Coelho, 2002; Youse & Coelho, 2009). The integrated treatment of related cognitive and discourse behaviours, as part of a broader approach that considers other psychosocial and emotional factors, may be a more prosperous approach to remediation (Lê et al., 2012; Yeates et al., 2004), where clinicians are encouraged to design and implement holistic approaches to management and consider a wide variety of factors that influence social competence (Whyte, 2014). The impact of lesion severity on the degree of cognitive (Schretlen & Shapiro, 2003) and communication impairment (Brookshire et al., 2000; Coelho et al., 2013) is well-established, as are the influences of these deficits on academic, social, and emotional outcomes (Galski, 1998; Janusz, Kirkwood, Yeates, & Taylor, 2002). This review is concerned with describing the lesser understood, yet crucial, aspect of social competence following ABI, which is the role of cognitive function in discourse production (Muscara, Catroppa, & Anderson, 2008).

The relationship between discourse and cognitive constructs has been proposed in theoretical models, such as the Structure Building Framework (SBF; Gernsbacher, 1991), and been explored in many previous studies (Coelho, 2002; Coelho, Liles, & Duffy, 1995; Hay & Moran, 2005; Mozeiko, Le, Coelho, Krueger, & Grafman, 2011; Tucker & Hanlon, 1998). Despite this, the degree to which existing literature has informed our understanding of the underlying cognitive mechanisms that underpin discourse deficits, and then direct future intervention research, has been limited by the variability in methodology and participant-related characteristics, as well as the dissimilarity (or otherwise) of behaviours across participants with ABI. This variation exists despite the development of common data elements that specify definitions of variables and assessment tools across psychosocial functioning in ABI (Miller, Odenkirchen, Duhaime, & Hicks, 2012; Wilde et al., 2010). Further, researchers' preference for monologic discourse analyses has constrained understanding of the impact of cognitive dysfunction on the discourse used within real-world contexts. Given the heterogeneity of the existing evidence base, a detailed synthesis of the literature is required to understand what is known regarding the underlying cause of cognitive-communication deficits at the discourse-level in speakers with ABI. This may provide the clearest direction for future research and have implications for the clinical management of discourse in this population.

The research question for this review was based on the PICO framework (Higgins & Green, 2011), and was formulated to investigate associations between cognitive function and discourse. This review collates and summarises the literature regarding acquired brain injury (P) in order to document the presence, and nature, of associations between performance on measures of cognitive functioning (I) and spoken discourse production (O).

Method

This systematic review follows the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement (Moher, Liberati, Tetzlaff, Douglas, & Group, 2009). A-priori inclusion criteria were established for the review process (Higgins and Green, 2011).

Protocol and Registration

The protocol for this systematic review was published via PROSPERO (record number: CRD42016051571) on the 28/11/2016, and can be accessed via the following link, www.crd.york.ac.uk/prospero/display_record.asp?ID=CRD42016051571.

Eligibility Criteria

The search included children and adults (no age limit applied) with non-progressive acquired brain injury, excluding stroke, and no prior history of communication and/or cognitive deficits. No restrictions were placed on injury-related factors such as mechanism, location, severity or time-post. Studies required the direct measurement of cognition and discourse production in participants with ABI and empirical association between these measures. The search was limited to peer-reviewed journal articles reporting empirical data, with no restrictions placed on study design. Time since publication was limited by the earliest recordings of each database.

Information Sources Initial database searches were conducted on 22/06/2016 through the following databases: Medline (1995 to Present), PsycINFO (1967 to Present), EMBASE (1995 to Present), CINAHL (1937 to Present), ProQuest (1971 to Present), Cochrane (1995 to Present), and ERIC (1966 to Present). Searches were supplemented by screening reference lists of relevant studies. Monthly electronic alerts were received for each database, which yielded one additional study. Prior to final reporting of the review, searchers were rerun across all databases limited to full text papers published between the initial search date and 11/09/2017.

Search

Key words and MeSH heading search terms were truncated, exploded and adjusted, and included: communication, discourse, cognition/cognitive function, and acquired brain injury. Text/keyword searches and subject heading (MeSH term) searches were combined for the following keywords: brain injur*, head injur*, ABI, TBI, CHI (combined with 'OR'), cognitive function*, cognitive process*, executive function*, 'theory of mind', attention, working memory, long-term memory, short-term memory, language, communication, 'cognitive communication', verbal behavio?r (to retrieve behavior and behaviour), narrative, and discourse. See Appendix D.1 for example search strategy from Medline (last searched 11/09/2017).

Study Selection

Citations were downloaded and exported to Endnote, with duplicates removed. Two reviewers (EH, MC) independently screened each title and abstract using a-priori inclusion/exclusion criteria. In the case of disagreement, meetings were held between the two reviewers, resulting in 100% consensus. Abstracts were retained for full text review if they met inclusion criteria.

Full Text Review and Data Extraction

Three authors (EH, AW, RW) undertook full-text review and data extraction using an electronic Microsoft Excel data extraction form. The extraction protocol was based on the Cochrane Handbook for Systematic Reviews of Interventions (Higgins & Green, 2011). Criteria reflected the PICO question. Demographic and injury-related characteristics including lesion location, severity, volume, and mechanism were noted. Assessment tools and specific criteria used to assess cognitive function and discourse were extracted. Specific measures used to characterise spoken discourse skills were categorised according to four levels of analysis (Coelho, 2007). Micro-linguistic measures were sensitive to within-sentence-boundary features, including productivity (quantity), syntactic complexity, word-level errors, and lexical diversity. Micro-structural measures indexed across-sentence characteristics, including the frequency and adequacy of cohesive ties. Macro-structural measures analysed between-sentence features, and included local (i.e. the degree to which content of an utterance relates to that which it follows) and global coherence (i.e. the relation of content of each utterance to the topic of the discourse) (Glosser & Deser, 1990), and Correct Information Unit (CIU) analysis (Nicholas & Brookshire, 1993), which measures the efficiency of production of words that are intelligible, accurate, and relevant. Super-structural measures related to analysis of the whole-text, including story grammar, tangential and repeated utterances, and 'completeness' of discourse content (Coelho, 2007). Measures reporting between group differences (e.g. mean, standard deviation) on discourse and cognitive variables were extracted. The outcomes of empirical associations between cognitive and discourse measures were also extracted and described, and key theoretical frameworks, if present, used to interpret results.

Assessment of Methodological Quality and Risk of Bias

The QualSyst assessment tool for quantitative studies was used to assess methodological quality of the studies that met inclusion criteria (Kmet, Lee, & Cook, 2004). This tool comprises 14 questions addressing method of participant recruitment, outcome measurements, and control of confounders. Scores for each item ranged from 0-2, or N/A when not applicable. Items five, six, and seven (relating to intervention studies/trials) were excluded as all studies were observational. Summary scores were calculated by transforming studies' raw scores into a percentage and were used to rate quality as strong (>80%), good (70-79%), adequate (50-69%), or limited (<49%) (Lee, Packer, Tang, & Girdler, 2009). In the case of disagreement, two reviewers discussed each score. In the case of discrepancies, a third independent reviewer was consulted. Reviewers sought to minimise risk of bias by analysing the included studies' reference lists, and receiving regular electronic alerts from included databases. As no registration procedure for observational studies is available, capacity to assess risk of bias in relation to reporting was limited.

Results

Study Selection

Searches yielded 2,269 unique abstracts after duplicates were removed. Following title and abstract screening and full-text review, 25 observational studies met inclusion criteria (see Figure 2). Database searching returned no intervention studies. Table 2.1provides individual study characteristics and variables of interest. The studies included in this review were published between 1991 and 2017, originating from America, Australia, Canada, France, Italy, Brazil, and New Zealand.

A total of 1143 participants with ABI and 322 controls from 23 unique participant groups were represented.

Five studies (Coelho et al., 2013; Coelho et al., 2012; Lê et al., 2012; Lê, Coelho, Mozeiko, Krueger, & Grafman, 2014; Mozeiko et al., 2011) reported data on the same controls and participants with shrapnel injuries, and two studies reported data on the same participants with ABI from a variety of causes (Coelho, 2002; Youse & Coelho, 2005). Twenty-three studies reported on adult participants and three included paediatric participants, mean age ranged from 11 to 59 years (Brookshire et al., 2000; Hay & Moran, 2005).

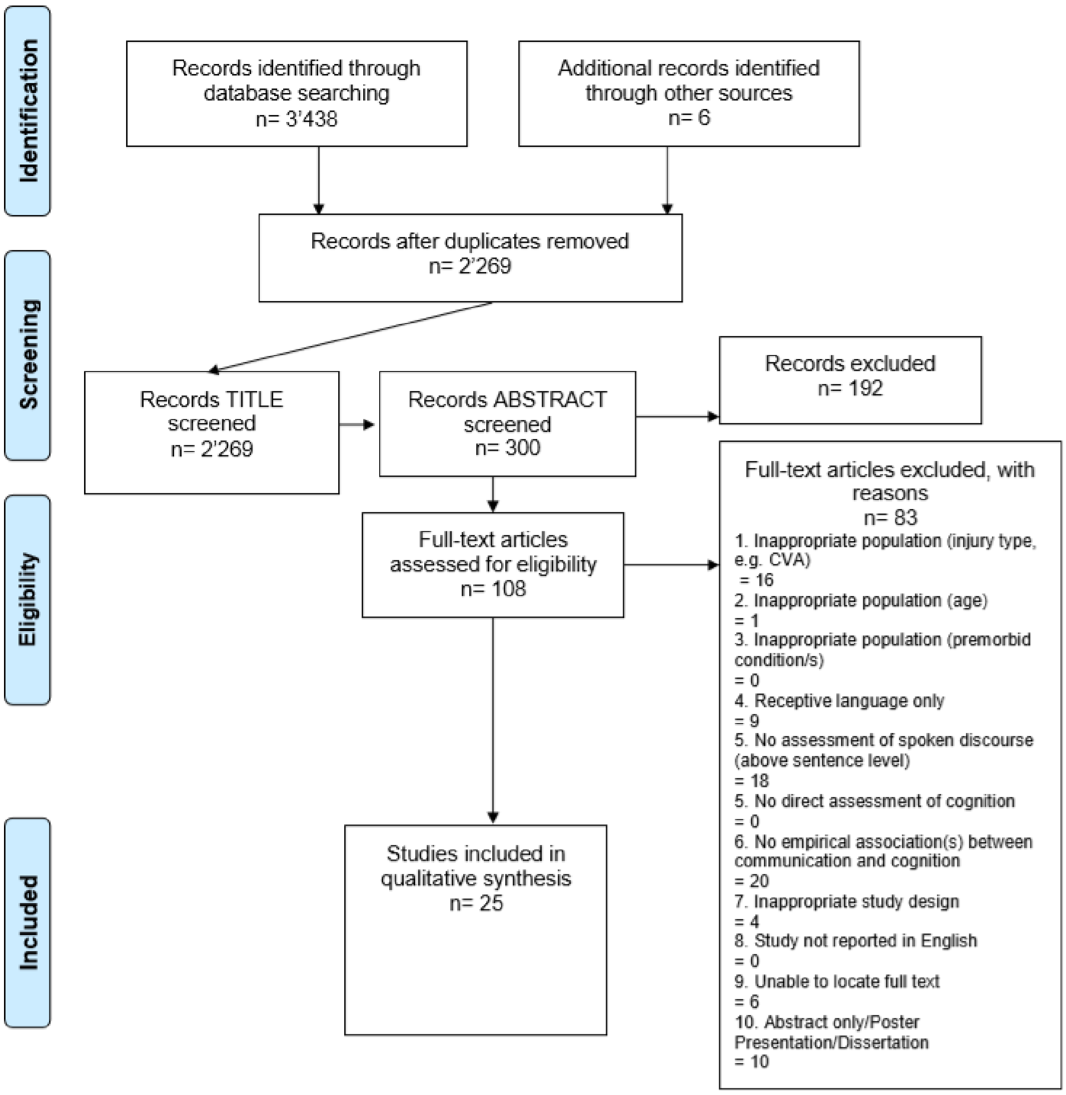

Figure 2. PRISMA Flow Diagram for the process of selection of included studies (Liberati et al., 2009).

One study specifically addressed adolescents with ABI (Moran et al., 2012). Injury severity was reported in most studies (*n*=20), most often using the Glasgow Coma Scale (Teasdale & Jennett, 1974). The most common mechanism of injury was motor-vehicle accidents. Fifteen studies provided specific information regarding injury pathology or the results of medical imaging. Table 2.2 summarises participants' demographic and injury-related characteristics across studies.

Measures of Cognition

All studies administered at least one standardised assessment of cognitive function (see Appendix D.2). A range of tools were utilised to characterise similar and different constructs. Cognitive assessments and their target functions are categorised and defined in accordance with their respective studies. For example, performance on the Montreal Cognitive Assessment (Nasreddine et al., 2005), in LeBlanc et al. (2014), is a screen of visuospatial/executive function, naming, attention, verbal fluency, concept formation, memory, and orientation, yet will be referred to as general cognitive ability (LeBlanc et al., 2014). Three tasks were classified as ecologically valid tests of cognitive function: The Functional Independence Measure – Cognitive component (FIM-Cog) (Keith, Granger, Hamilton, & Sherwin, 1987), a combined measure of problem-solving and memory (Hammond, Hart, Bushnik, Corrigan, & Sasser, 2004), the Interpersonal Reactivity Index (Davis, 1980), a measure of empathy and Theory of Mind (McDonald et al., 2014), and the Neuro-behavioural Rating Scale – Revised (NRS-R) (McCauley et al., 2001; Rousseaux, Vérigneaux, & Odile, 2010). The ecological validity of the remaining cognitive assessments does warrant consideration, standardised tools may not reveal subtle cognitive deficits (Chevignard, Soo, Galvin, Catroppa, & Eren, 2012).

Measures of Discourse Production

Multiple discourse genres were sampled across studies; there was, however, a clear preference for monologic over dialogic genres, with this impacting the results of this review. Four studies administered standardised assessments of communication within a discourse context (Appendix D.2), and the remaining studies used informal tasks. Five studies measured discourse using formalised scoring procedures or those included in standardised communication assessment tools. The remaining studies analysed discourse using individual measurements classified into micro-linguistic, micro- structural, macro-structural, and super- structural features. Measures of micro-linguistic features were most variable, while a more homogenous set of indices characterised macro- and super-structural discourse features.

Table 2.1
Study characteristics and outcomes of interest

#	Author (Year)	Country	Study design	Sample (*N*) ABI	Sample (*N*) C	Outcomes of interest: Cognitive	Discourse: Level of analysis	Discourse: Measure area	Discourse: Genre	Assoc?	Quality: QS	Quality: Rating[d]
1	Hartley & Jensen (1991)	US	Case-control	11	21	WM; memory	All	Productivity; maze analysis; cohesion; critical components	NR; NG; P	✓	63.6	Adeq
2	Coelho et al. (1995)	US	Cross-sectional	32	n/a	GenEF	Micro_l; Micro_s;Super_s	Syntax; cohesion; story grammar	NR	✓	59.1	Adeq
3	Snow et al. (1998)	Aus	Case control	50	26	SustainedA; verbal fluency; WM; memory; proc. speed; IQ	Micro_l; Macro_s;Super_s	Productivity; informativeness; tangentiality	C	✓	81.8	Strong
4	Brookshire et al. (2000)	US	Prognostic	91	n/a	GenEF; planning; verbal fluency; inhibition; dividedA; memory; proc. speed; IQ	Micro_l; Macro_s;Super_s	Productivity; syntax; story grammar;	NR	✓	81.8	Strong
5	Coelho (2002) [a]	US	Case-control	55	47	GenEF	Micro_l; Micro_s;Super_s	Productivity; syntax; cohesion; story grammar	NR; NG	✓	77.3	Good
6	Hammond et al. (2004)	US	Prospective cohort	292	n/a	GenEF; prob-solve; sustainedA; memory; proc. speed; IQ	All	FIM-Cog score	n/a	✓	86.4	Strong
7	Hay & Moran (2005)	NZ	Case-control	9	9	WM	Micro_l; Macro_s;Super_s	Productivity; syntax; story grammar	NG; E	✓	77.3	Good
8	Youse and Coelho (2005) [a]	US	Cross-sectional	55	n/a	WM; memory	Micro_l; Micro_s;Super_s	Productivity; syntax; cohesion; story grammar	NR; NG	✓	63.6	Adeq
9	Chapman et al. (2006)	US	Case-control	38	24	Updating	Micro_l; Micro_s;Macro_s	Cohesion; coherence	NR	✓	90.6	Strong
10	Rousseaux et al. (2010)	France	Case-control	35	16	Neuro-behaviour; shifting; verbal fluency; selectiveA;	Micro_l; Macro_s;Super_s	Multiple	C	✓	72.7	Good

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Study characteristics and outcomes of interest

#	Author (Year)	Country	Study design	Sample (*N*) ABI	Sample (*N*) C	Outcomes of interest: Cognitive	Discourse: Level of analysis	Discourse: Measure area	Discourse: Genre	Assoc?	Quality: QS	Quality: Rating[d]
11	Marini al. (2011)	Italy	Case-control	28	14	GenEF; sustainedA; memory; STM	Micro_l; Micro_s;Macro_s	Multiple	NG	x	77.3	Good
12	Mozeiko et al. (2011) [b]	US	Cross-sectional	167	46	Shifting; planning	Super_s	Story grammar	NR	✓	68.2	Adeq
13	Zimmermann et al. (2011)	Brazil	Cross-sectional	7	n/a	GenEF; sustainedA; inhibition; WM	Micro_l; Macro_s;Super_s	Multiple	NR; C	✓	45.5	Limited
14	Coelho et al. (2012)	US	Case-control	15	46	WM	All	Multiple	NR	✓	86.4	Strong
15	Le et al. (2012) [b]	US	Cross-sectional	167	46	WM; memory;	Super_s	Story grammar; completeness	NR	✓	86.4	Strong
16	Matsuoka et al. (2012)	Japan	Case-control	24	24	GenEF; shifting; WM	Micro_l; Macro_s	Productivity; informativeness; efficiency	NG	✓	86.4	Strong
17	Moran et al. (2012)	NZ	Case-control	8	8	WM	Micro_l; Micro_s;Super_s	Productivity; maze analysis; syntax; story grammar; tangentiality	E	x	72.7	Good
18	Coelho et al. (2013) [b]	US	Case-control	167	46	Shifting; WM; memory; IQ	All	Productivity; syntax; cohesion; coherence; story grammar; completeness	NG	✓	90.9	Strong
19	Galetto et al. (2013)	Italy	Case-control	10	13	GenEF; sustainedA; memory;	Micro_l; Macro_s;Super_s	Productivity; syntax; informativeness story grammar	NG	✓	68.2	Adeq
20	Peach (2013)	US	Cross-sectional	16	6	Concept formation; sustainedA; verbal fluency; WM; memory; IQ	Micro_l	Productivity; maze analysis; syntax	D	✓	68.2	Adeq

Table 2.1
Study characteristics and outcomes of interest

#	Author (Year)	Country	Study design	Sample (*N*) ABI	C	Outcomes of interest: Cognitive	Discourse: Level of analysis	Measure area	Genre	Assoc?	Quality: QS	Rating[d]
21	Le et al. (2014) [b]	US	Prospective cohort	167	46	Shifting; WM; memory; IQ	All	Productivity; syntax; cohesion; coherence; completeness; story grammar	NR	✓	90.9	Strong
22	LeBlanc et al. (2014)	Canada	Cross-sectional	95	n/a	GenCog; WM	Micro_l; Macro_s;Super_s	D-MEC score	C	✓	90.9	Strong
23	Marini et al. (2014)	Italy	Cross-sectional	10	20	GenEF; sustainedA; verbal fluency; memory;	Micro_l; Macro_s;Super_s	Productivity; word-level errors; syntax; coherence; connectedness	NG	✓	81.8	Strong
24	McDonald et al. (2014)	Aus	Case-control	25	28	SustainedA; verbal fluency; WM; memory; ToM; social inference; IQ	Macro_s	Correctness	E; D	✓	86.4	Strong
25	Marini et al. (2017)	Italy	Case-control	40	20	GenEF; memory; sustainedA	Micro_l; macro_l; Super_s	Productivity; word-errors; syntax; coherence; informativeness; completeness	NG	✓	72.7	Good

Note: # = study number; C = control group, Assoc = association found between cognition and discourse variables; QS = QualSyst Score (Kmet, 2004); Adeq = QualSyst 'Adequate' rating (Kmet, 2004).

Table 2.2

Participant Characteristics

	Demographic Information					Injury Characteristics						
								Severity Criteria				
#	Subgroup	Age at test (years)[a]	Age at injury (years)[a]	Edu (years)[a]	Matched controls	TPO (mo)[a]	Loc.	GCS	LOC	PTA	Rating [b]	Cause
1	n/a	26.7(7.77)	-	13.4(1.69)	✓	-	-	-	✓		Severe	-
2	n/a	26.2	-	-	n/a	6	-	-			-	-
3	Initial Follow-up	26.2 (7.8) 28.5 (8.1)	-	12.42	✓	4.5(1.05) 34.78(5.83)	Multi	-	-	✓	Severe	-
4	Mild Severe	11.68 (2.39) 12.19 (2.58)	7.96 (2.78) 7.76(2.82)	-	n/a	3.72(1.6) 44.64(19.2)	-	✓	-	-	Mild – Severe	MVA; ped vs car
5	n/a	28.6	-	13.0	✓	10.5	Multi		✓	-	Mild – Severe	Fall; MVA; ped vs car
6	n/a	36.3 (15.6)	-	-	n/a	-	-	-	-	-	-	MVA; ped vs car; assault; sport; other
7	n/a	12.08 (1.82)	3.20(3.57)	Year 5-Year 10	✓	106	-	-	-	-	-	Fall; MVA; ped v car; hypoxic injury; other
8	n/a	28.6	-	13.0	n/a	10.5	Multi		✓		Mod. – Severe	Fall; MVA; ped vs car
9	Mild Severe	13.6 (1.3) 12.7(1.7)	8.2(1.9) 7.4(1.4)	-	✓	>24	-	-	-	-	-	-
10	Rehab Chronic	32.9 28.0	32.3 26.5	10 11.5	✓	17.13 121.6	-	✓			Severe	-

Table 2.2

Participant Characteristics

	Demographic Information					Injury Characteristics						
								Severity Criteria				
#	Subgroup	Age at test (years)[a]	Age at injury (years)[a]	Edu (years)[a]	Matched controls	TPO (mo)[a]	Loc.	GCS	LOC	PTA	Rating [b]	Cause
11	n/a	35.4 (8.5)	-	10.9(2.6)	✓	68.5(38)	-	✓	✓		Severe	-
12	n/a	57.99 (2.47)	-	14.84(2.46)	✓	408-444	Multi	-	-	-	Severe	Shrapnel
13	n/a	32 (11.78)	-	12.14(1.57)	n/a	25(31.73)	Multi	-	-	-	Mild – Severe	-
14	L-DLPFC R-DLPFC	57.4 (1.52) 59.00 (3.20)	-	14.8(3.35) 13.9(2.85)	✓	-	L-DLPFC R-DLPFC	-	-	-	-	Shrapnel
15	n/a	58.09 (2.60)	-	14.82(2.48)	✓	408-444	Multi	-	-	-	Severe	Shrapnel
16	n/a	35.9 (10.1)	24.2 (11.3)	<10 - >15y	✓	142.1(101.2)	-		✓		Severe	Fall; pedestrian vs car; other
17	n/a	14.5	5.25(2.58)	7-13 (range)	✓	Min 84	-	-	-	-	Mod. – Severe	Fall; MVA; ped v car; medical mishap
18	L-PFC R-PFC Bi-PFC L-nonPFC R-nonPFC Bi-nonPFC	58.80 (1.35) 57.40 (2.54) 57.80 (2.34) 58.50 (2.44) 58.54 (2.30) 57.65 (2.60)	-	14.6(2.2) 14.2(2.5) 14.0(2.5) 15.25(2.9) 15.0(1.93) 15.0(1.93)	✓	408-444	R/L/Bi/ Non - DLPFC	-	-	-	Severe	Shrapnel
19	n/a	35.4 (10.8)	-	10.5(2.9)	✓	39.1(8.3)	-	✓			Mild	-
20	n/a	26.1 (6.0)	-	13.5(2.0)	✓	6.3(.5)	-	-	-	-	Severe	-
21	n/a	58.11 (2.63)	-	14.82(2.48)	✓	408-444	-	-	-	-	Severe	Shrapnel

Table 2.2

Participant Characteristics

	Demographic Information					Injury Characteristics		Severity				
								Criteria				
#	Subgroup	Age at test (years)[a]	Age at injury (years)[a]	Edu (years)[a]	Matched controls	TPO (mo)[a]	Loc.	GCS	LOC	PTA	Rating [b]	Cause
22	n/a	54.9(23.2)	-	Elementary to 14	n/a	-	-	-	-	-	Mild – Severe	Fall; MVA; ped vs car assault; other
23	n/a	36.6 (10.8)	-	11.0(2.6)	✓	22.4(7.2)	-	✓	-	-	Mod.	-
24	n/a	48.2 (12.0)	-	13.4(3.3)	✓	13.6(9.0)	R/L Hemi		-	✓	Mod. - Severe	Fall; MVA; assault; sport
25	Moderate Severe	36.55(10.22) 35.80 (8.15)	-	11.00(2.51) 10.25(2.55)	✓	31.35(11.17) 65.85(47.07)	-	✓	-	-	Mod - Severe	-

Notes: R/L/Bi/Non, right/left/bi/non-prefrontal cortex; R/L DLPFC, right/left dorsolateral prefrontal cortex; hemi, hemisphere; TPO, time post-injury; n.a., not applicable to the study; GCS, Glasgow Coma Scale (mild, score of 13–15, moderate, 9–12, and severe < 8); LoC, loss of consciousness/coma (mild, < 20 min, moderate, < 6 h, severe, > 6 h); PTA, post-traumatic amnesia (mild, < 60 min, moderate, < 24 h, severe, > 24 h), with < 60 min as mild ABI, < 24 h moderate and > 24 h as severe.

[a] Values provided are mean (SD) where possible.

[b] As defined by the author(s).

Assessment of Methodological Quality

The studies included in this review were of a good quality, with total QualSyst (Kmet et al., 2004) scores ranging from 41% to 91% (M=77.1, SD =11.6). Ten studies were rated as 'Strong', seven as 'Adequate', six 'Good', and one as 'Limited'. Given the relative strength of studies included in this review, the results have not been separated according to quality. See Table 2.1 (above) for individual scores and Appendix D.5 for a detailed breakdown of methodological quality. Areas of weakness included the provision of relevant participant characteristics, a lack of standardised discourse assessments, gender bias, limited sample size, and inadequate consideration of confounds

Participant Performance

The results of statistical group-level comparisons on measures of discourse and cognitive function are provided below. ABI-related deficits were defined as the presence of a significant difference between participants with and without injury, and between participants with milder relative to more severe injuries. Few studies included in this review investigated the influence of injury- and participant-related factors on discourse and cognitive function following ABI. When studies did explore these effects, and these results were significant, they have been summarised in Appendix D.3 and Appendix D.4 and addressed below.

Cognitive assessment. Executive function was the most commonly assessed cognitive construct (n=25). Assessments of executive function were explicitly defined, albeit inconsistently, and covered general executive function, verbal fluency, and inhibition, updating, and working memory. Studies also assessed memory (n=16), attention (n=10), intelligence (n=6), processing speed (n=2), neuro-behavioural functioning (n=1), general cognitive ability (n=1), and Theory of Mind (ToM; n=1). Fourteen studies conducted statistical group-level comparisons of performance on cognitive tasks (see Appendix D.3). Five studies provided no comparison data (Coelho, 2002; Coelho et al., 1995; Matsuoka, Kotani, & Yamasato, 2012; Snow, Douglas, & Ponsford, 1998; Youse & Coelho, 2005), three documented the proportion of participants with reduced cognitive performance (Hammond et al., 2004; Peach, 2013; Zimmermann, Gindri, de Oliveira, & Fonseca, 2011), and two reported descriptive statistics alone (Lê et al., 2012, 2014). Participants with ABI demonstrated reduced executive function, memory, attention, general cognitive ability and intelligence relative to controls. Profiles of impairment were heterogeneous, likely due to inconsistency in, and limited ecological validity of, formal neuropsychological assessment tools (Chevignard et al., 2012).

Discourse assessment. Discourse genres elicited included narrative (*n*=21), conversation (*n*=4), exposition (*n*=2), procedure (*n*=1), and description (*n*=2). Micro-linguistic discourse features were most frequently measured (*n*=22), followed by super-structural (*n*=20), macro-structural (*n*=20), and micro-structural (*n*=11) indices Twenty-one studies reported statistical group-level comparisons on measures of discourse and communication (summarised in Appendix D.4). Of the remaining studies, two provided descriptive statistics (Lê et al., 2012, 2014), and two documented proportions of participants exhibiting discourse difficulties (Hammond et al., 2004; Zimmermann et al., 2011).

Micro-linguistic features. Speakers with ABI exhibited heterogeneous impairments across measures of productivity, lexical diversity, maze production, intelligibility, and the incidence of semantic and phonological paraphasias. More complex output was observed in narrative assessments (Hay & Moran, 2005), milder injuries (Brookshire et al., 2000; LeBlanc et al., 2014; Marini et al., 2011) and ABI sustained later in life (Brookshire et al., 2000). Milder injuries were also associated with fewer word-level errors (LeBlanc et al., 2014).

Micro-structural features. Reduced cohesive adequacy was observed in speakers with ABI (Chapman et al., 2006; Hartley & Jensen, 1991; Marini et al., 2011), while contradictory results were also reported (Coelho et al., 2013; Coelho, Lê, et al., 2012; Coelho, 2002; Hartley & Jensen, 1991). Milder injuries were associated with more cohesive output (Chapman et al., 2006), as were narrative retells relative to generation tasks (Coelho, 2002; Hartley and Jensen, 1991), and procedures compared to narratives (Hartley & Jensen, 1991). One study reported more cohesive output in speakers with a higher socioeconomic status, irrespective of the presence of ABI (Coelho, 2002).

Macro-structural features. Speakers with ABI provided less essential information and were inefficient in transferring critical information to the listener. Less coherent discourse was also observed, particularly at the global level, i.e. the logical organisation of content according to the general topic. Speakers who sustained injuries earlier in life produced impoverished and less coherent discourse (Brookshire et al., 2000). Larger lesions were also associated with reduced informativeness (Marini, Zettin, Bencich, Bosco, & Galetto, 2017) and poorer coherence (Brookshire et al., 2000; Le et al., 2014; LeBlanc et al., 2014), although this finding was inconsistent (Marini et al., 2017).

Super-structural features. Results revealed ABI-related impairment in the use of discourse schemata, i.e. story grammar, to produce complete episodes, which lead to the production of tangential and redundant output. One study revealed narratives to be more intact and enriched compared to expositions (Hay & Moran, 2005). Others found speakers with more severe injuries and those sustained earlier in life to lack adequate relevance and organisation of information (Brookshire et al., 2000; LeBlanc et al., 2014; Marini, Zettin, Bencich, Bosco, & Galetto, 2017). One study documented significant super-structural impairment only following lesions in the left dorsolateral prefrontal cortex (L-DLPFC) (Coelho et al., 2013).

Association Between Discourse and Cognitive Variables in ABI

Twenty-three studies reported significant associations between discourse and cognitive variables at each level of discourse analysis. The majority of these associations occurred with broad executive function, working memory, and attention. Twenty-one of which reported significant associations in monologic discourse. The significant outcomes of univariate and multivariate correlational analyses are discussed below, and provided in Table 2.3 and Table 2.4, respectively.

General verbal communication. Executive function, selective attention and verbal fluency were associated with generalised deficits in verbal communication as indexed by the Lille Communication Test (LCT; Rousseaux et al., 2010). These functions, with the addition of memory and general cognitive ability, also impaired verbal pragmatic behaviour on the Montreal Protocol for the Evaluation of Communication (D-MEC; LeBlanc et al., 2014). Zimmerman et al (2011) did not support this finding despite having administered the same assessment. Executive function, attention, and processing speed associated with improvements in general communication skills following ABI (Hammond et al., 2004). Multiple regression analyses confirmed memory, problem solving, and intelligence as significant predictors of improvement in communication (Hammond et al., 2004).

Table 2.3

Significant univariate regression analyses *(study #)*

	Cognitive														
	Executive Function								Attention			Other			
Discourse	GenEF	VF	Plan	Inhib	WM	Cog Flex	Update	Con. Form	Sus	Sel	Memory	Gen Cog	Proc Speed	IQ	Neuro-behav
General verbal communication	.42 (#22) -.82 (#10) TMTB: .00 (#6) ‡ WCST: .008 & .005 (#6) ‡ .42 (#6) †	.61 (#10)	-	-	.43 (#22)	-	-	-	-.32 (#22)	-.74 (#10)	WMS: .20 (#22) Hopkins: 38 to .47 (#22) .011 (#6) ‡ .42 (#6) †	.58 (#22)	.008 & .012 (#6) ‡	.041 (#6) ‡	-.89 to -.64 (#10
Micro_L															
Total utterances	.19 (#18) .25 (#4)	-	- .24 (#4)	-	NRT: .63 (#7) CLPT: .70 (#7)	-	-	-	-	-	.24 (#18)	-	-	.32 (#18; 21)	-
Total words	-	-	-	-	NRT: .57 & CLPT: .70 (#7)	-	-	-	-	-	.73 to .74 (#1)	-	-	-	-
Words per utterance	-.37, .33, .33, .39* (#5) .27 (#18)	-	-	-	-	-	-	-	-	-	.29 (#8)	-	-	-	-
Speech rate	.43 to .45 (#11)	.35 to .42 (#22)	-	-	.50 (#16)	-	-	-	-	-	not provided (#1) .15 to .24 (#22) ·45 to .49 (#25)	.15 (#22)	-	-	-
Sample duration	-.39 (#16)	-	-	-	-	-	-	-	-	-	.60 to .71 (#1)	-	-	-	-

Table 2.3

Significant univariate regression analyses (*study #*)

	Cognitive														
	Executive Function								Attention			Other			
Discourse	GenEF	VF	Plan	Inhib	WM	Cog Flex	Update	Con. Form	Sus	Sel	Memory	Gen Cog	Proc Speed	IQ	Neuro-behav
Pausing	-	-	-	-	-	-	-	-	-	-	.53 [#20]	-	-	.62 (#20)	-
Syntactic complexity	.27[#4] -.33 to -.34 [#5]	.34 (#4)	-	-	-.74 (R-DLPFC) .82 (L-DLPFC) (#14) .30(#8; WMS-DS) .32(#8; WMS-AS)	-	-	-	-	-	.-	-	-	-	-
Mazes	-	-	-	-	-	-	-	-.55 (#20)	-	-	-	-	-	-	-
Paraphasias	-	.22 to .55 (#22)	-	-	.29 (#22)	-	-	-	-	-	.26 to .28 (#22)	.36 (#22)	-	-	-
Lexical informativeness	-.37 to -.59 (#23) -.76 [#19]	-	-	-	-.49[#25]	.52 (#25)	-	-	-	-	-.79[#19]	-	-	-	-
Micro_S															
Cohesion	-	-	-	-	.60[#1]	-	-	-	-	-	.79[#1]	-	-	-	-
Cohesive adequacy	-	-	-	-	.27 to .33[#9] .84 (#14; LDLPFC)	-	-	-	-	-	.34[#8]	-	-	.29 (#21)	-
Macro_S															

Table 2.3

Significant univariate regression analyses *(study #)*

	Cognitive														
	Executive Function								Attention			Other			
Discourse	GenEF	VF	Plan	Inhib	WM	Cog Flex	Update	Con. Form	Sus	Sel	Memory	Gen Cog	Proc Speed	IQ	Neuro-behav
Local coherence	.27(#21) .39 to .74(#23)	-	-	-	.67 (#14; RDLPFC) .84 (#14; L-DLPFC) .51(#25)	-.55 (#25)	.27 to .33 (#19)	-	-	-	-	-	-	-	-
Global coherence	.27(#21) .58(#23)	-	-	-	.86 (#14; L-DLPFC)	-	-	-		-	-.68(#18)	-	-	-	-
Efficiency	.43 to.45(#16) .48 to .56(#16)	-	-	-	.44(#16) .50 (#16)	-	-	-	-	-	-	-	-	-	-
Super_S															
Story grammar	.33(#18; #21) .32(#15) .34(#12)	-	-	-	.15(#15) .85(#14; L-DLPFC)	-	-	-	-	-	.31 (#18; 21) .32 (#15)	-	-	.33 (#18; 21)	-
Total episodes	.24(#4) .33(#12) .51(#2) -.30 to -.28 (#5)	-	-	-	NRT: .69 (#7) CLPT: .78(#7)	-	-	-	-	-	.36(#8)	-	-	-	-
Completeness	.28(#4) .43(#15; 18; 21)	.30 (#4)	-	-	.29 (#18; 21) .31(#15) NRT: .66 (#7) CLPT: .70(#7)	-	-	-	-	-	.49 (#21) .51(#15)	-	-	.54 (#18; 21)	-
Essential information	WCST: -.70 to -.82 (#13) TMT: .68 (#13)	.65 to .78 (#13)	-	-.60 to -.72(#13)	.63 & .64(#7) .67 to .81(#13)	-	-	-	-.62 (#13)	-	.68 to .89(#1) -.51(#25)	-	-	-	-

Table 2.3

Significant univariate regression analyses (*study #*)

	Cognitive														
	Executive Function								Attention			Other			
Discourse	GenEF	VF	Plan	Inhib	WM	Cog Flex	Update	Con. Form	Sus	Sel	Memory	Gen Cog	Proc Speed	IQ	Neuro-behav
Information transfer	.49 (#3)	-.41 (#3)	-	-	-	-	-	-	-	-	-.35 (#3)	-	-	-	-
Accuracy of expression (all #22)	-.29	-	-	-	.35	-	-	-	-.22 to -.25	-	.23 to .35 WMSDigitF: .18	.44	-	-	-
Topic maintenance (all #22)	.34	.21 to .39	-	-	-	-	-	-	-	-	Hopkins: .19	.23	-	-	-
Appropriateness (all #22)	-	.34	-	-	.32	-	-	-	- -.20	-	.15 to .24	.35	-	-	-
Repetitiveness	-.29 (#22)	.26 to .38 (#22)	-	-	.32 (#22)	-	-	-	- -.30 (#22)	-	.18 to .25 (#22) -.48 (#25)	.27 (#22)	-	-	-

Note: Micro_L = micro-linguistic features; Micro_S = micro-structural features; Macro_S = macro-structural features; Super_S = super-structural features; GenEF = general executive function; VF = verbal fluency; Plan = planning; Inhib = inhibition; WM = working memory; Cog Flex = cognitive flexibility; Update = updating; Con Form = concept formation; Sus = sustained attention; Sel = selective attention; Gen Cog = general cognitive function; Proc Speed = processing speed; Neuro-behav = ‘general neurobehavioural function’

Table 2.4
Significant multivariate regression analyses

Discourse variable	Executive functioning	Concept formation	Memory	IQ	General cognitive ability
Total utterances				β=.45[a]	
Pauses				β =. 62[b]	
Mazes		β = -.55[b]			
Local coherence	β=.34[a]				
Global coherence	β=.25[a]				
Correct details	β= .349 to .650[c]				
Completeness			β=.24[a]	β=.42[a]	
General communication				*p*=.045*[d1]	*p*=.014*[d 1]

Note: [a] Le et al. (2014), [b] Peach (2013), [c] McDonald et al. (2014); [d] Hammond et al. (2014); [1]improvement; *coefficients not provided

Micro-linguistic features. Lower scores on assessments of intelligence, memory, working memory, and executive function, were related to reduced productivity in terms of speech rate and length at the word- and utterance-level (Brookshire et al., 2000; Coelho, 2002; Coelho et al., 2013; Hartley & Jensen, 1991; Hay & Moran, 2005; Lê et al., 2014; Marini et al., 2017; Matsuoka et al., 2012; Moran et al., 2012; Youse & Coelho, 2005). Intelligence, memory, and concept formation were also related to less efficient discourse, inter- and intra-utterance pausing and mazes (Peach, 2013), i.e. the presence of words or utterance fragments that did not add to the meaning discourse (Loban, 1976). For Marini et al (2017), the association between speech rate and memory occurred only in speakers with moderate as opposed to severe ABI. Memory positively correlated with informativeness (Galetto, Andreetta, Zettin, & Marini, 2013), which was also associated with executive function (Marini et al., 2014). Reduced intelligibility related to neuro-behavioural and executive dysfunction, poor verbal fluency, working memory, and attention (Rousseaux et al., 2010), as did the production of phonological and semantic errors (LeBlanc et al., 2014; Rousseaux et al., 2010). Cognitive deficits also influenced sentence-level organisation. Impairments in attention (Rousseaux et al., 2010), memory (Youse & Coelho, 2005), executive function, verbal fluency (Brookshire et al., 2000; Coelho, 2002), and working memory (Coelho et al., 2012), related to less complex syntactic structure.

Micro-structural features. ABI-related deficits in intelligence (Lê et al., 2014), memory (Youse & Coelho, 2005), working memory, and updating (Chapman et al., 2006; Coelho, Lê, et al., 2012) were associated with the production of less cohesive output. Two studies indicated an effect of lesion location and task on the association between cohesion and cognition. Coelho et al. (2012) documented this relationship only in speakers with L-DLPFC lesions. Hartley and Jensen (1991) found both memory and working memory to correlate with cohesion in narrative retell and generation tasks, with no associations present in procedures.

Macro-structural features. Executive function (Lê et al., 2014; Marini et al., 2014; Marini et al., 2017), attention (Marini et al., 2017), memory (Galetto et al., 2013), and working memory (Chapman et al., 2006; Coelho et al., 2012) were linked to reductions in local and global coherence. Coelho et al. (2012) found significant associations between working memory and local and global coherence in speakers with L-DLPFC lesions, whereas no correlations were evident in speakers with damage to the right DLPFC. Marini et al. (2017) documented an association between shifting and local coherence with moderate injuries and between sustained attention and local coherence only in speakers with severe ABI.

Performance on tests of executive function predicted local and global coherence in narrative and expository discourse. A significant association between executive function and output accuracy was observed in expositions, but not in narrative samples (McDonald et al., 2014). Executive dysfunction (Snow et al., 1998), working memory (Matsuoka et al., 2012), memory (Hartley & Jensen, 1991; Snow et al., 1998) and shifting (Marini et al., 2017) deficits were associated with discourse lacking in essential and accurate content, and the inefficient transfer of information.

Super-structural features. More intact neuro-behavioural and executive function, working memory, intelligence and declarative memory (Brookshire et al., 2000; Hay & Moran, 2005; Marini et al., 2017; Mozeiko et al., 2011; Youse & Coelho, 2005), was associated with the better use of discourse schemata to organise episodes, resulting in more ‘complete’ output.

For Coelho et al. (2012), the association between working memory and discourse organisation occurred only for speakers with L-DLPFC lesions. Neuro-behavioural functioning, executive control, and attention, correlated significantly with tangentiality in discourse (Rousseaux et al., 2010). These cognitive constructs, verbal fluency, and demands placed on ToM were related to inappropriate commenting

(LeBlanc et al., 2014) and the reduction in contextually relevant information in discourse following ABI (McDonald et al., 2014).

Association Between Discourse and Cognitive Variables in Controls

Studies provided limited information regarding cognitive and discourse associations in controls. No significant associations were found between performance on measures of executive function and story grammar (Mozeiko et al., 2011). Chapman et al. (2006) performed correlations using data collapsed across control and ABI groups, as the associations between memory and discourse measures did not differ across participant groups.

Discussion

The purpose of this review was to synthesise the results of previous research investigating the functional association between discourse and cognitive profiles in speakers with ABI. This review aimed to enhance our understanding of the nature and underlying cause of cognitive-communication deficits at the discourse level following ABI. Twenty-five studies were identified that described associations between cognitive function and discourse in this population, predominantly within the context of monologic discourse. Consistent with previous studies, we found variation in methodology, terminology, and demographic features which constrained the ability to draw robust conclusions as to the nature of these relationships and their breakdown in speakers with ABI. In particular, the dominance of monologic discourse has resulted in a restricted understanding of the cognitive processes underpinning daily conversational deficits in speakers with ABI. Additionally, little insight could be gained into the cognitive mechanisms behind discourse production in non-injured speakers.

An exploration of the cognitive mechanisms that subserve discourse is required in order to fully understand discourse deficits following ABI and to develop effective treatment. In the discussion that follows, we summarise the impact of ABI on cognition and discourse, and explore the cognitive mechanisms related to discourse deficits across micro-linguistic to super-structural levels of analysis. We conclude with a discussion of results in light of Gernsbacher's SBF (1990) and clinical implications of the review.

Cognition following ABI

Reduced performance was identified across each cognitive construct assessed. These cognitive profiles were not surprising as, although there was heterogeneity in the mechanisms and locations of injury across studies, there was a dominant profile of damage to the frontal, temporal, and temporo-parietal areas, which is reflective of the general ABI population (Gennarelli & Graham, 1998). These frontal areas are implicated in executive functioning and attentional control (Rabinowitz & Levin, 2014), the retention and application of novel information, and verbal communication (Mar, 2004). Limited agreement across studies on the measurement and characterisation of cognitive behaviours may have contributed to varied profiles of cognitive deficit in participants with ABI. Assessment of executive function was most inconsistent, as a range of tasks were utilised, each claiming to target a single, or multiple, executive behaviours. Often, studies, which adopted the same assessment tool, characterised target behaviours using different score types.

Discourse following ABI

Micro-linguistic and micro-structural features. This review documented ABI-related deficits in productivity, lexical diversity, syntactic complexity, maze production, and the presence of phonological and semantic paraphasias across monologic and conversational discourse. Speakers with ABI also demonstrated comparable performance on micro-linguistic measures to speakers without injury (e.g. Galetto et al., 2013; Moran et al., 2012), which supports the view that deficits at this level are infrequent in this population. This has been attributed to the reduced susceptibility of the cortical regions sub-serving these behaviours to damage (Ulatowska, North, & Macaluso-Haynes, 1981). In the absence of aphasia, cognitive-communication deficits at this level are likely to indicate higher-level difficulties in planning and organising discourse (Marini et al., 2017). Profiles at the micro-structural level were also inconsistent. Some studies found poorer cohesion in participants with ABI relative to those without (e.g. Chapman et al., 2006; Hartley & Jensen, 1991; Marini et al., 2011), others no difference (e.g. Coelho, 2002; Coelho et al., 2012), and some found differences across severity groupings, discourse tasks, and demographic factors (Chapman et al., 2006; Hartley & Jensen, 1991; Coelho, 2002).

Macro-structural and super-structural features. Participants with ABI demonstrated more consistent difficulties with the organisation and efficient transfer of accurate information, manifesting in tangential and redundant content. As with other levels of analysis, macro- and super-structural discourse features were influenced by injury- and task-related factors (e.g. Brookshire et al., 2000; Chapman et al., 2006; Hay & Moran, 2005). The differences in organisation and accuracy across genres suggest potential disparity in their cognitive and/or linguistic demands, which warrants further consideration.

The Role of Cognition in Discourse Following ABI

This review supports general consensus that discourse deficits in speakers with ABI are related to cognitive impairment (Mar, 2004), particularly of executive function, working memory, and memory. Results also indicated that other cognitive functions such as attention, intelligence, and processing speed are also implicated, yet reveal more sporadic associations with discourse, which may be a result of demographic and methodological variation across papers. Our ability to generalise the results of this review to the impact of cognitive deficits on everyday discourse production is also confounded by the lack of information on dialogic discourse. At this stage, associations discussed here may be considered as reflective of the requirements of monologic discourse.

Executive function.

Micro-linguistic and micro-structural features. Numerous associations between micro-linguistic features and executive function were observed. Participants with ABI-related executive deficits produced shorter discourse (e.g. Marini et al., 2011), which may be attributed to changes in the ability to retrieve and organise content. Contradictory associations were found, as participants with executive deficits also overproduced discourse (e.g. Marini et al., 2011), which could be a compensatory mechanism to account for the poorly planned and impoverished content. Abnormal verbosity may also relate to an inability to inhibit irrelevant comments, and avoid unnecessary repetition of information. A purely linguistic breakdown is an unlikely explanation for reduced informativeness, simpler sentence structures, and anomia. These deficits were associated with reduced cognitive speed, concept formation, and interruptions to the flow of thoughts and planning, particularly the ability to generate and shift between discourse episodes and suppress the insertion of irrelevant or ambiguous content (e.g. Brookshire et al., 2000; LeBlanc et al., 2014; Marini et al., 2017). In contrast, there were no significant associations found between cohesion and executive function. This was surprising given that cohesive behaviours facilitate local coherence, which has been significantly associated with executive function

Macro-structural and super-structural features. Our systematic review identified executive dysfunction, as well as poor cognitive flexibility and updating, to be associated with reduced local coherence (e.g. Coelho et al., 2013; Lê et al., 2014; Marini et al. 2014; 2017). Errors of local coherence seem attributable to difficulty shifting between concepts when generating new episodes, updating lexical information to reflect new referents, and failure to inhibit unclear referents. Errors in global coherence, the relation of an utterance to the overall topic, and inefficient information transfer also reflect poor planning and organisation and a failure to inhibit derailments of content. Based on these findings, executive dysfunction appears to hinder speakers' use of previously learnt mental representations of discourse structure to organise content, produce complete episodes, and control the intrusion of incongruent information. This is supported by this review, which documented associations between broad executive function indices, and specific measures of verbal fluency and inhibition.

Working memory.

Micro-linguistic and micro-structural features. The data suggest that impaired ability to hold and manipulate information in working memory is related to reduced productivity, less complex syntax, and anomia in speakers with ABI (e.g. Coelho et al., 2012; Hay & Moran 2005; Youse & Coelho, 2005). Correlations between micro-linguistic features and working memory observed in the context of narrative retell may reflect similar processing demands across both tasks (e.g. Coelho et al., 2012; Youse & Coelho, 2005). Results also indicate that more intact working memory processes allowed for the more frequent and accurate production of cohesive ties, with possible dominance of the left-hemisphere in this process (Coelho et al., 2013).

Macro-structural and super-structural features. Studies suggest that poor retention and manipulation of information in working memory negatively influenced participants' ability to link concepts using appropriate cohesive ties. The results also indicate this difficulty is implicated in poor global coherence and informativeness, as speakers with ABI appear unable to monitor what has already been said, and subsequently produce irrelevant and tangential utterances (e.g. Marini et al., 2017). Again, there is some evidence to suggest a potential hemispheric difference in this relationship (Coelho et al., 2013). Participants with working memory deficits exhibited failed topic maintenance, and produced redundant information, possibly due to a reduction in the amount of information held in working memory, and/or a lack or misallocation of resources required to hold, manipulate, and reproduce content. Similarly, relationships revealed in narrative retell samples (e.g. Coelho et al., 2102; Lê et al., 2012), are likely to reflect the similarities in demands across tasks.

Memory.

Micro-linguistic and micro-structural features. Findings from these previous studies indicate that better memory is associated with greater productivity (Coelho et al., 2013), and more efficient production in narrative retell (e.g. Hartley & Jensen, 1991; Youse & Coelho, 2005), generation (e.g. Coelho et al., 2013; Galetto et al., 2013; Marini et al., 2017), procedural (e.g. Hartley & Jensen, 1991) and conversational discourse (LeBlanc et al., 2014). Results also revealed a relationship between intact memory and adequate linking of concepts and characters using cohesive ties (e.g. Hartley & Jensen, 1991; Youse & Coelho, 2005). Overall, the data suggest links between memory, micro-linguistic, and micro-structural features are unlikely to result from lexical or motor-speech difficulties. Instead, they signal a failure in the efficient retrieval information from memory and ability to keep it active long enough to plan and maintain a constant flow of content at the whole-text and sentence-level.

Super-structural features. The findings indicate that relationships between discourse and memory at the super-structural level reflect diminished memory resources, and the subsequent use of inefficient strategies for the recall and/or retention of verbal information. Hartley and Jensen (1991) documented the strategy of "If you do not remember it, provide whatever information you can, even though it may be irrelevant or inaccurate", in participants with ABI compared to the strategy of "if you do not remember, so indicate" (p. 280) in those without injury. This strategy refers to the retrieval of discourse schemata and the specific information to enrich it. This is supported by significant associations between memory and story grammar, as well as the redundancy and relevance of output. Performance on memory tasks also requires set-shifting, planning and the organisation of information to facilitate the retrieval of content, therefore it is worth considering that associations between memory and discourse may be partly attributable to executive dysfunction (Lê et al., 2014).

Attention.

Micro-linguistic and micro-structural features. Anomia was the only micro-linguistic feature to associate with attention, specifically sustained attention (Marini et al., 2017). Sustained attention allows us to focus on our own output, so results suggest that participants with ABI-related attention deficits may be unable to keep track of what they have said, and to monitor the direction of discourse. This may lead to the production of non-specific or ambiguous referents and difficulty retrieving appropriate words. As with executive deficits, poor sustained attention may lead to deficits at the word-level difficulties, but reflect broader issues with planning and self-monitoring discourse.

Macro-structural and super-structural features. Results revealed an association between memory and discourse coherence (Kurczek & Duff, 2011). This suggests memory processes are required to recall and connect successive events (Cohen & Banich, 2003), which can be thought of as co-occurrences and links between characters, settings, and episodes in narrative, or materials and steps in procedure. Studies indicate that memory deficits underpin the inability to retrieve and link events according to their relationships and relevance to the topic. Two studies documented an association between sustained attention deficit and breakdown of discourse super-structure (LeBlanc et al., 2014; Zimmermann et al., 2011), which is unsurprising given that the frontally distributed networks that mediate sustained attention is particularly vulnerable to damage in ABI (Gennarelli & Graham, 1998). The findings suggest that sustained attention deficits reduce speakers' ability to focus on, and keep track of, the on-going discourse, which results in poor topic maintenance and unnecessary repetition of content.

Intelligence.

Micro-linguistic and micro-structural features. The studies' findings showed that participants with higher intelligence scores post-injury were more productive in narrative retells and paused less during descriptive discourse (e.g. Coelho et al., 2013; Lê et al., 2014), Intelligence refers to our ability learn and apply information, problem solve, think abstractly and comprehend complex concepts (Gottfredson, 1997). Measures of intelligence draw on working memory, cognitive flexibility, and problem solving, which are sub-served by shifting, inhibiting, and updating. This suggests these functions are implicated in the relationship between intelligence and micro-linguistic features. The observed relationship between intelligence and cohesion may also involve other cognitive variables. Speakers with ABI may be unable to retain verbal information long enough to process referential, temporal, and causal relationships between concepts, which translates poor use cohesive ties to achieve local coherence.

Super-structural features. Participants with ABI-related impairment on measures of intelligence exhibited poor use of story grammar and produced incomplete samples (Coelho et al., 2013; Lê et al., 2014). If intelligence can be thought of as a process that required a range of cognitive ability, these findings may reflect other relationships between super-structure, executive function, memory, and attention documented in this review.

Theory of Mind.

The included studies documented a reduced ability to draw on Theory of Mind (ToM) to recognise shared understanding following ABI, which manifested in reduced informativeness and increased verbosity (McDonald et al., 2014). ToM is our capacity to acknowledge the thoughts, opinions, and emotions of others, and is required when speakers need to shift between, and suppress, their own perspective in order to adopt another (McDonald et al., 2014). It may be that, on one hand, impaired ToM processes make a unique contribution to discourse deficits, particularly in recognising required versus redundant information, while, on the other, they reflect a broader relationship between discourse and executive dysfunction.

Cognition and Discourse in Control Participants

Mozeiko et al (2011) suggested the lack of significant associations between cognitive performance and discourse measures in controls indicates differing strategies for episode generation. Speakers with brain injury rely heavily on diminished cognitive, particularly executive, resources during discourse production, whereas this process may be more natural and less taxing on cognitive function for speakers without injury. Chapman et al (2006) revealed similar interactions between memory, coherence and cohesion in participants with ABI and controls. This insight into the cognitive mechanisms involved in typical discourse production, albeit limited, warrants further investigation, as does the general lack of information regarding this interaction across studies.

Drawing on the Structure Building Framework

The cognitive constructs discussed in this review are analogous to those referenced in Gernsbacher's SBF (1990), and their roles are supported by the included studies. This model identifies memory and executive function, particularly shifting, inhibition, and updating, as requirements for the production of coherent and well-organised output. The SBF also accounts for the role of cognitive deficits in micro-level features via interdependence between content and structure (Marini et al., 2017).

Laying the foundation for discourse requires the retrieval of discourse schemata from memory, the components of which are then appropriately sequenced using executive resources. This process is supported by the data in this review, particularly by associations between episode structure, memory, and executive behaviour. Retrieving and mapping relevant information onto this foundation facilitates the production of coherent output, as content must be planned and logically ordered according to the discourse frame. Information that is required to complete the current episode is retrieved from memory and continuously updated in working memory, so that it may be inserted into the framework accurately according to temporal, causal, and referential relationships. This also involves the ability to monitor information, update information, and shift between processing and storage demands (St Clair-Thompson & Gathercole, 2006). The results suggest that difficulty establishing and updating referential relationships is related to an inability to hold and manipulate information in working memory long enough to determine and maintain changing lexical representations. This may also require ToM in order to judge whether activated content is relevant to context and to listener knowledge, which is also consistent with the results. Additionally, establishing relationships between content requires sentence-level planning and formulation, impairment of which may manifest in word-level errors, mazes and pausing. Information that is activated in memory and is not relevant to the current episode, but required by subsequent events, is temporarily inhibited and held in working memory. This prompts a shift to a new episode, which occurs via the suppression of the preceding episode and the enhancement of new content. Information that is completely incongruent to the topic is supressed entirely (Gernsbacher, 1990).

Our ability to map results of onto the SBF (Gernsbacher, 1990) suggests a developing understanding of the cognitive mechanisms that mediate discourse production. Despite this, it is difficult to identify a specific level of breakdown in ABI due to the complex nature of cognitive-communication, as well as the influence of varied task-, injury- and speaker-related factors. Further, due to the involvement of memory, shifting, inhibiting, and updating in each stage of the SBF, it is possible that there are multiple areas of deficit in speakers with brain injury.

Clinical Implications and Future Directions

This review has implications for our understanding, and the clinical management, of cognitive-communication impairments in ABI. The results confirm the presence of significant associations between cognitive functioning and discourse characteristics, although these conclusions have been drawn from a limited number of studies. The significant paucity of formal discourse-based assessments is likely to directly underpin the lack of data here, underscoring a need for greater attention to the development of suitable tools. Recommendations for the use of common outcome measurements aim to improve consistency of psychosocial research in ABI (Honan et al., 2017). From a discourse perspective, the methodological inconsistency observed in this review highlights the need to develop and evaluate standardised discourse protocols[4]. This supports recently published recommendations that encourage clinicians and researchers to use discourse-based resources such as TBI Bank

[4] This is addressed in Chapter 4 (Study 3) of this research program

(http://www.talkbank.org/tbibank/) to assess communication following ABI (Honan et al., 2017; MacWhinney et al., 2018). Raising awareness of the clinical utility of these resources, may improve consistency of discourse research, and facilitate translation of results into the clinical context.

The cognitive bases of discourse features identified within the included studies are consisted with constructs within the SBF (Gernsbacher, 1990), which indicates the potential clinical and empirical relevance of this model in ABI research. A promising direction for future research with speakers with ABI lies in the detailed application of the SBF (Gernsbacher, 1990) with this population. Future studies should closely examine the executive and memory processes involved in laying a foundation, the retrieval and mapping of information, and episode generation across different genres. Particular attention should be paid to shifting, inhibiting, and updating in these stages, using specific measures instead of broad executive indices. This would enhance our understanding of the areas of breakdown in this population, and the underlying cognitive processes responsible for observed difficulties, providing a theoretical and empirical foundation for the development of targeted assessment and treatment protocols. The heavy focus on monologic discourse further prompts the need for exploration into the cognitive and linguistic demands of conversation, given its unstructured, spontaneous nature, and high ecological validity as a target in clinical management. This may also be strengthened by exploration of the impact of pragmatic and contextual variables such as the impact of varied speaker roles and the presence of communication partners on the quality of conversation following ABI. This would likely have direct impact on the management of discourse in this population with the provision of supports by communication partners to potentially compensate for specific cognitive deficits and facilitate better organisation of discourse content (Togher, Taylor, Aird, & Grant, 2006).

The severity, site, and chronicity of lesions as well as demographic factors appear to impact discourse deficits in different ways, the investigation of which would provide insight into the deficits exhibited by this heterogeneous population. Perhaps the nature of the relationship between discourse and cognitive processes changes as we age, which may impact management of cognitive-communication deficits across the lifespan. Discourse in paediatric ABI should be a focus for future research given the lack of information revealed by this review and the vast changes to the brain and complexity of social interactions that occur during adolescence. Similarly, the cognitive bases for discourse production in non-injured speakers would also provide a benchmark to compare variability in the characteristics of discourse deficits, and inform diagnostic criteria in clinical populations [5].

Limitations

First, studies not written in English were excluded in this review however the search did not identify any non-English studies that met inclusion criteria. Time of publication was limited by the earliest recordings in each database, such that this review may not have included older studies that are not available online. Meta-analysis of results was not conducted due to variation across studies. Increased consistency in descriptions, common measures, and ABI-related data elements (Maas et al., 2010) would allow for data synthesis in future research. Studies included a range of participant demographics and injury severities, aetiologies, and locations. As males are more likely to sustain brain injuries (Munivenkatappa, Agrawal, Shukla, Kumaraswamy, & Devi, 2016), and the majority of participants in the studies reviewed were drawn from the military population, the gender bias was not unexpected. Readers should therefore interpret this review considering the impact of these factors on impairment profiles and the generalisation of results. The majority of studies also employed cross-sectional research designs, which limited capacity to draw conclusions regarding causality and strength of effect. Finally, limitations in power and the control of confounds are common in ABI research, given the potential difficulty with participant recruitment and the heterogeneity of this clinical population.

Conclusions

Individuals with ABI can experience impairments in discourse production that are likely to be underpinned by cognitive dysfunction. Variability in impairment profiles is, further, likely attributed to inherent heterogeneity in injury- and non-injury-related factors, as well as methodological inconsistencies in the measurement of discourse and cognition. Further analysis of the way in which discourse production draws on cognition is required, using well-defined measures in larger and more homogenous samples, with particular attention paid to conversational

[5] This is addressed in Chapter 6 (Study 5) of this thesis

discourse. Future research should also focus on exploring cognitive mechanisms required in typical discourse production, which has direct implications for the management of impaired populations.

Chapter 3

Exploring Current Clinical Practice for Discourse in Paediatric ABI

Chapter Overview

This chapter presents an international survey of clinical practice for discourse impairments in children and adolescents with ABI (<18 years of age). The scope of this survey study was broadened to include clinicians with experience working with any individual under the age of 18 years with a history of brain injury.

In reviewing the literature, Chapter 1 discussed the current paucity of literature published resources to guide assessment and intervention planning for discourse in paediatric ABI. The inconsistent methodology in discourse assessment and analysis was highlighted as a barrier to synthesising the literature on discourse and cognition in Study 1. The systematic review also documented the lack of empirical studies in the context of paediatric ABI. An awareness of the relationship between discourse and cognition as well as the functional, psychosocial impact of cognitive-communication disorders is imperative for clinical practice in ABI (MacDonald, 2017; Togher et al., 2014). In the context of limited exploratory research into the links between these domains of function and limited literature to support assessment and treatment planning for discourse in paediatric ABI, there is a need to explore current clinical practice. While previous studies have examined cognitive-communication and discourse assessment in paediatric ABI (Frank et al., 1997; Frith, 2014), to current knowledge, no study has undertaken a comprehensive study into discourse assessment and treatment practices in this population.

The aim of this study was to extend the work of Frank et al. (1997) and Frith (2014) and review current clinical practice for the assessment and management of discourse in paediatric ABI (<18 years). The results of the survey will empirical and clinical gaps to be addressed in future investigations, including this thesis, which inform evidence-based practice for this population.

The contents of this chapter have been prepared as a manuscript for publication. As a result, there is repetition of some literature and definitions provided elsewhere in this thesis, yet every effort has been made to avoid this where possible.

Introduction

Paediatric acquired brain injury (ABI) is a worldwide health issue; affecting around 2000 per 100,000 children and adolescents each year in first world countries such as Australia, the United Kingdom, and the United States (Crowe et al., 2009; Faul et al., 2010; National Institute for Health and Care Excellence, 2014). An ABI can lead to persistent and pervasive deficits in communication (MacDonald, 2017). For this reason, speech-language pathologists (SLPs) play a crucial role in the rehabilitation process. A key responsibility for clinicians working with this population, particularly in the long term, is to assess and manage cognitive-communication disorders (Morgan et al., 2017). These include impairments in language and communication skills that results from deficits in underlying cognitive function (Coelho, 2007; Turkstra et al., 2015). Often, the full extent of these impairments is not fully observed in standardised assessment, which does not reflect complexities of real-world interaction (Coelho, 2007). The need for ecologically valid tasks is also emphasised in intervention where clinicians are encouraged to provide "an opportunity to rehearse communication skills in situations appropriate to the context in which the individual will live, work, study, and socialise" (Togher et al., 2014, p. 359). For this reason, existing literature and clinical guidelines advocate for a focus on discourse-level language skills (Coelho, 2007; Morgan et al., 2017).

Discourse refers to the use of language beyond the level of the sentence, to achieve a specific communication goal, whilst adhering to contextual and pragmatic expectations (Sullivan & Riccio, 2010). A focus on discourse skills is congruent with the WHO ICF-CY (WHO, 2007), which guides the formulation of holistic therapy goals aligned with the domains of Activity and Participation. In considering communication competence, current guidelines also encourage clinicians to consider other factors across "Body Structure and Function" (e.g. cognitive functions, physical health), "Activity" (e.g. conversation, debate, storytelling) and "Participation" (e.g. social versus academic tasks and interactions), and "Environment" (e.g. family and friends, motivation) domains, given each can influence outcomes post-injury (Anderson et al., 2012; Morgan et al., 2017). This also involves consultation of multidisciplinary literature and collaborative practice during clinical decision-making (MacDonald, 2017). This has also been recently exemplified in MacDonald's (2017) model of cognitive-communication. While not specifically designed for paediatric ABI, this model serves as a guide to collaborative and holistic assessment and intervention planning in this population as it delineates cognitive, communicative, physical, emotional, and contextual influences on daily communication competence that may exist following brain injury.

The nature of discourse deficits in paediatric ABI, including how they relate to other domains of function, have, however, been investigated less frequently than the adult population (Chapman et al., 2001; Chapman et al., 2004; Moran et al., 2012). There is little empirical evidence available to support clinical decision-making in this population such that the assessment and treatment of discourse deficits may be a challenging area of clinical practice for speech-language pathologists (Coelho, 2007; Steel & Togher, 2019). Given the prevalence of paediatric ABI and potential consequences for discourse skills, it is imperative to examine current practices of clinicians who work with discourse-level communication in this population and understand where and how future practices may be developed.

Assessment of Spoken Discourse in Childhood ABI

By assessing language at the discourse level, clinicians are able to add valuable information relating to communication competence at the level of Activity and Participation of the ICF-CY (Coelho, 2007; WHO, 2007). In turn, it also serves as an ecologically valid measure of change in therapy (Coelho, 2007; Miller et al., 2016). Clinical guidelines for the assessment of cognitive-communication skills are available through international speech language bodies such as The American Speech-Language-Hearing Association (ASHA) (ASHA, 2003), and The College of Audiologists and Speech Pathologists of Ontario (CASLPO) (CASLPO, 2018). Both refer to the assessment of receptive and expressive word, sentence, and discourse-level language as a practice standard in clients with ABI, yet provide little guidance on assessment procedures, particularly the elicitation, analysis, or interpretation of discourse. Furthermore, only the CASLPO guidelines (2018) make recommendations specific to paediatric ABI.

In their review of standardised assessments, the Academy of Neurologic Communication Disorders (ANCDS) recommended a single measure, the Test of Language Competence – Expanded (Wiig & Secord, 1989) for use in paediatric ABI, despite limited evidence for its use in this population (Turkstra et al., 2005). More recently, the Common Data Elements TBI Outcomes Workgroup (McCauley et al.,

2012) recommended a wider range of standardised measures, including the Peabody Picture Vocabulary Test (Dunn & Dunn, 2007) and Clinical Evaluation of Language Fundamentals – Fourth edition (Semel et al., 2003), for the assessment of language and communication in paediatric ABI (McCauley et al., 2012). The earlier ANCDS review concluded that clinicians should exercise "caution when evaluating individuals with cognitive-communication disorders using existing standardized tests" (Turkstra et al., 2005, p. 220) due to limited sensitivity to higher-level communication deficits in ABI, particularly in everyday discourse (Bishop & Baird, 2001). As a result, subsequent guidelines encouraged parallel administration of non-standardised, informal assessments to profile real-world communication skills (ASHA, 2003; Coelho, 2007; Coelho, Ylvisaker, & Turkstra, 2005; Morgan et al., 2017).

In their review of non-standardised assessment methods, the ANCDS (Coelho et al., 2005), underscored the need to assess skills across a range of socially and academically relevant genre. This is reiterated in recently published clinical guidelines in paediatric ABI (Morgan et al., 2017). For this population, it is recommended that assessment reflect the requirements of daily contexts such as conversation, personal recount, and narrative, and later-developing genres such as expository and persuasive discourse (Turkstra, 2000; Westby, 2014). The ANCDS (Coelho et al., 2005) also suggest that outcome measures sensitive to the quality, quantity, and organisation of discourse content should be used to distinguish impaired from 'typical' discourse following brain injury. The wider discourse literature does, however, vary greatly in the elicitation tasks and analysis procedures reported to profile discourse-level language features across a range of genres (Coelho et al., 2005; Coelho, 2007). In a likely response to this, attention has been paid to the development of standardised protocols that might enhance consistency in research and clinical practice. This has, however, occurred for the adult ABI population only. The TalkBank database (MacWhinney et al., 2018), for example, is a large collection of discourse samples developed by Interagency Workgroups on Common Data Elements (CDE) in Traumatic Brain Injury Research. TBIBank (MacWhinney et al., 2018) is a freely available repository of TalkBank (see https://tbi.talkbank.org), which provides a discourse elicitation protocol formulated specifically for adult ABI. This includes standardised instructions for eliciting and scoring data for adult discourse, along with normative data, across a range of measures (MacWhinney et al., 2018). Similarly, the Curtin University Discourse Protocol (CUDP) (Whitworth et al., 2015) was published as a standardised framework for eliciting and analysing adult discourse, with a particular focus on adults with aphasia. Recently, the CUDP was used to assess discourse skills in adults with cognitive-communication impairment (Whitworth, Ng, Timms, & Power, 2020). These protocols may facilitate translation of recommendations regarding discourse assessment to clinical practice (Steel & Togher, 2019), but there are few equivalent databases or protocols of spoken discourse for paediatric ABI to provide direct guidance for clinicians working with this population. Adolescent discourse assessment is an area of increasing interest. For instance, Heilman and Malone (2014) recently developed standardised elicitation and scoring protocols and normative data for expository discourse assessment available through the Systematic Analysis of Language Transcripts (SALT; Miller et al., 2019). Even more recently, Heilman et al. (2020) published an analysis and scoring protocol and normative data for adolescent persuasive discourse, and Hill et al. (2020) published the Curtin University Discourse Protocol – Adolescent version, which guides elicitation and scoring of recounts, narrative, expository, and persuasive discourse with corresponding reference data for word to whole-text level measures. These protocols are a valuable resource available to clinicians, however the degree to which they are utilised in clinical practice for ABI is not known. Given the relative paucity of discourse assessments that enable consistent measurement of an array of language features across a range of genres, it is unsurprising that past research has documented clinicians' ongoing preference for traditional standardised lexical and syntactic assessments over discourse in this population (Frith, 2014). In the context of the limited evidence-base identified by past researchers (Coelho, 2007; Steel & Togher, 2019; Turkstra et al., 2015), and acknowledged in current guidelines (Morgan et al., 2017) it is important to establish current clinical decision-making specific to assessment of discourse skills in children and adolescents with ABI.

Treatment of Spoken Discourse in Childhood ABI.

According to Morgan et al. (2017), "there is currently insufficient published research to form an EBR [evidence-based recommendation] on effective treatment strategies and techniques to treat language disorders following TBI" (p.37). This is particularly the case for discourse interventions in paediatric ABI. This situation is not consistent with current clinical recommendations that encourage SLPs to treat communication impairments and measure outcomes "at the level of participation in everyday social life" (Togher et al., 2014, p. 361). While remediating discourse-level deficits would facilitate targeting these real-world communication skills, current recommendations are only available for the treatment of cognitive-communication deficits more generally (Laane & Cook, 2020). The approaches currently recommended for cognitive-communication in paediatric ABI include forms of direct remediation, forms of top-down cognitive training approaches such as metacognitive strategy instruction (MSI) and strategic learning, and modifications to the communication environment (Laane & Cook, 2020; Turkstra et al., 2015).

Evidence supporting direct remediation for cognitive-communication deficits in this age group is scarce, with studies showing inconsistent results for improved cognitive functioning (Oberg & Turkstra, 1998), vocabulary (Thomas-Stonell et al., 1994), and verbal pragmatic behaviour (Wiseman-Hakes et al., 1998). Studies have, however, provided preliminary evidence of the effectiveness of direct remediation for discourse structure in adults with ABI (Cannizzaro & Coelho, 2002). Beyond this, there has been little attention paid to direct discourse treatment for this population, despite the success of oral narrative intervention programs in school-age children, with and without language impairment (Glisson, Leitão, & Claessen, 2019; Petersen & Spencer, 2016; Spencer et al., 2013; Westerveld & Gillon, 2008), and conversational skills intervention in adolescents with Autism Spectrum Disorder (Laugeson, Frankel, Gantman, Dillon, & Mogil, 2012).

MSI and strategic learning have been effective in improving some cognitive processes in children and adolescents with brain injury (Chapman & Mudar, 2014; Kennedy et al., 2008), the use of either approach for discourse-level difficulties has not been examined. Finally, accommodation is regarded as the most clinically practical approach to intervention for cognitive-communication in paediatric ABI, yet there is no evidence of environmental or contextual modifications for treating discourse skills (Turkstra et al., 2015; Ylvisaker, Hartwick, & Stevens, 1991). This is despite evidence supporting communication partner interventions such as TBIExpress in adults with ABI (Togher, McDonald, Tate, Power, & Rietdijk, 2013).

Ultimately, there appears to be a mismatch between clinical and empirical recommendations and the evidence and resources available for clinicians to implement in clinical practice (Morgan et al., 2017; Steel & Togher, 2019; Turkstra et al., 2015). As with assessment, the paucity of literature supporting discourse interventions may lead to inconsistency in clinical practice, or may prevent clinicians from actively targeting discourse in clients with ABI (MacDonald & Wiseman-Hakes, 2010). There has been, however, no previous exploration of current clinical practice patterns of SLPs working to both assess and treat discourse in this population and which may then serve as a guide for future research to addresses clinical and empirical gaps that serve as barriers to clinical practice.

The Current Study

In the context of a limited evidence base for clinical decision-making, and the potential consequences of poor discourse skills on daily function (Morgan et al., 2017; Turkstra, 2000), it is imperative to examine current practices of clinicians who work with this population, as they relate to available literature, sand understand where and how future practices may be developed. This study aimed to identify and describe current assessment and treatment practices, internationally, of SLPs for children and adolescents (<18 years) with ABI. Using an online survey, the following research questions were addressed:

1. Which levels of language (i.e. word, sentence, discourse level) are assessed and treated by clinicians working with children and adolescents with ABI?
2. What are the current assessment practices of clinicians working in paediatric ABI for discourse-level language skills, specifically related to assessment tools, genres assessed and outcome measurements used?
3. How do SLPs manage discourse-level language skills in paediatric ABI, specifically related to approach, context, and outcome measurements?
4. What existing theoretical models/frameworks and empirical literature inform clinical decision-making for discourse-level language deficits in paediatric ABI?
5. What are the barriers and facilitators to assessment and intervention for discourse-level language in this population?

Method

Participants

SLPs working in Australia, New Zealand, the United Kingdom (UK), United States (US), Canada and the Asia Pacific region with experience in paediatric ABI were invited to participate in an online survey via purposive and snowball sampling. The study was advertised via social media and publications of international speech-language pathology bodies. Potential participants were also identified through publicly available databases of Speech Pathology Australia, New Zealand Speech-Language Therapists Association, Royal College of Speech and Language Therapists, and American Speech Language Hearing Association, as well as special interest groups.

Survey Design

Survey questions and content were informed by previous research on clinical practice for cognitive-communication in ABI (Frith, 2014), available clinical guidelines (ASHA, 2003; CASLPO, 2018; Coelho et al., 2005; Morgan et al., 2017; Turkstra et al., 2005), and empirical literature. The survey was developed and disseminated via Qualtrics online software (Qualtrics, 2005). The survey was trialled on one speech pathologist and one psychologist who commented on survey length, structure, content, and clarity of questions. The survey was updated where necessary. Following this process, the survey consisted of 28 questions separated into four categories 'Demographic Information' (*n*=7), 'Assessment' (*n*=10), 'Intervention (*n*=8), and 'Theory and Literature' *(n*=3). The survey is provided in supplementary material.

In the 'Demographic Information' section, respondents were asked to provide their origin country (open-ended question / text box) and geographic location of practice, clinical setting, years of experience, and age of clients seen with a history of ABI (all checkbox from pre-determined list). The 'Assessment' section surveyed levels of language assessed, assessment tools and outcome measures and barriers and facilitators to discourse assessment. The 'Intervention' section surveyed levels of language targeted, frequent approaches to intervention, outcome measures, and barriers and facilitators to treatment. As in Frith (2014), this study also surveyed clinicians' attitudes towards discourse assessment and treatment. This included clinicians' confidence in the assessment and treatment of discourse skills, perceptions of the importance of targeting discourse in this population, current evidence-base, and the effectiveness of discourse interventions. Finally, the 'Theory and Literature' questions surveyed use of theoretical models and frameworks, frequently cited/consulted empirical literature, and clinicians' perspectives on priorities for future research. As in Frith (2014), questions used Likert scales of frequency in which quantifiers included: Never = 0% of the time, Infrequently = <25% of the time, Somewhat Frequently = 25-50% of the time, Frequently = 50-80% of the time, and Routinely >80% of the time, multiple choice (e.g. years of experience, clinical setting, barriers to clinical practice), and open response text boxes (e.g. country of origin, facilitators of clinical practices, and theoretical models). Open response boxes were also used for 'Other' responses to enable respondents to provide additional detail. To survey clinicians' attitudes towards assessment and intervention, participants were invited to rate their level of agreement in response to a series of statements. Questions that evaluated levels of agreement involved a five-point scale: 'Strongly Disagree', 'Disagree', 'Neutral', 'Agree', and 'Strongly Agree'. Extreme responses (strongly agree/disagree) are often less likely to be selected (Leung, 2011). As a result, agree/disagree and strongly agree/disagree were combined for the purposes of this study, as in past research (Frith, 2014).

Analysis

Responses from Qualtrics were downloaded into SPSS to calculate frequencies and proportions of responses. To improve readability and facilitate discussion of results, the data was collapsed in the following ways. As in Frith (2014), Countries were reduced to four groups: Australia/New Zealand, the UK, US/Canada, and the Asia Pacific; years of experience was grouped into: 1- 3 years, 4 to 10 years, 7 to 15 years, and > 15 years; clinical contexts were grouped into: acute, inpatient rehabilitation, outpatient rehabilitation, private practice, and school-based services, and clinical setting was grouped into: urban, regional, rural, and remote.

Results

Responses

One-hundred and twenty-eight SLPs commenced the survey. Forty-three respondents did not progress past the consent page of the questionnaire. A further eight respondents indicated no experience working in paediatric ABI. Seventy-seven clinicians provided demographic information, 53 completed the 'Assessment' section, and 36 completed 'Intervention' and 'Theory and Literature'.

Participant Demographics

Respondents represented a range of clinical settings, geographic settings, experience levels, and ages of clients with ABI (see Table 3.1). The largest proportion represented clinicians with 10 to 15 years of experience in paediatric ABI (31%). There was an even distribution across the remaining categories (17 to 21%), excluding less than one year of experience where n=0. The largest sample represented community rehabilitation services (40%) followed by an even distribution across inpatient (24%) and private practice (21%). Clinicians also worked in home-based rehabilitation services (3%) and other clinical settings (5%), which included tertiary academic institutions (n=3) and 'return-to-work' agencies (n=1). The majority of respondents worked within metropolitan areas (58%) followed by regional (19%), rural or remote (7%) or a combination of geographical settings (10%). Clinicians most frequently reported servicing secondary school-age children ABI (64%), although also reported managing school-aged primary (58%), young children (44%), and infants (32%).

Table 3.1
Demographic information of respondents

Question	Responses	n of responses (N = 77)	% of responses
Years of experience	<1	0	0
	1 to 3	13	17
	4 to 10	16	21
	10 to 15	24	31
	>15 years	14	18
Clinical setting	Inpatient (acute)	16	21
	Inpatient (rehab)	24	31
	Community outpatient	31	40
	Private practice	21	27
	School-based	11	14
	Home-based	3	4
	Other	4	5
Geographical setting	Metropolitan	47	58
	Regional	15	19
	Rural / Remote	6	7
	Combination	8	10
Age of client with ABI	Infant (0 to 2y)	25	32
	Young child (3 to 5y)	34	44
	School-age Primary (6 to 12y)	45	58
	School-age Secondary (13 to 18y)	49	64

Language Targets in Assessment and Intervention

Assessment. In terms of receptive language, sentence-level (n=42; 80%) comprehension was the most frequent or routine assessment target, followed by word (n=40; 76%), then discourse level language (n=36; 67%) (see Figure 1). Similarly, for expressive language, sentence-level skills were the most frequent or routine target (*n*=45; 84%), followed by word (*n*=41; 78%) and discourse skills (*n*=40; 76%). The majority also selected non-verbal pragmatic skills (*n*=41; 78%) and motor speech (*n*=37; 69%) as frequent or routine targets. Literacy was the least frequent or routine target (*n*=3; 6%).

Intervention. For receptive language, sentence-level comprehension was the most frequent or routine target of intervention (*n*=25; 74%), followed by discourse (*n*=23; 63%), and word-level comprehension (*n*=22; 60%). For expressive language, clinicians most frequently or routinely targeted sentence- and discourse-level skills (both *n*=25; 74%) followed word-level skills (*n*=24; 66%).

Twenty-four respondents (66%) frequently or routinely targeted non-verbal pragmatic skills, and two (4%) frequently or routinely targeted literacy. See Figure 3 for a comparison of language levels targeted in assessment versus intervention.

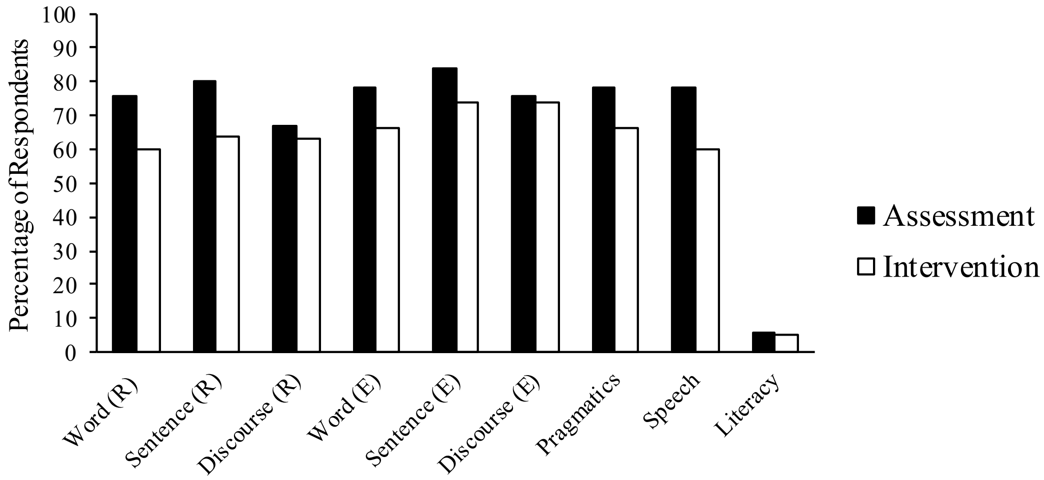

Figure 3. Receptive (R) and expressive (E) language levels identified as frequent/routine targets of assessment versus intervention.

Assessment Methods for Spoken Discourse

Thirteen clinicians (25%) indicated frequent or routine administration of standardised, norm-referenced tasks to assess discourse skills. The remaining 40 (75%) either never or infrequently administer standardised tools. Twelve clinicians identified specific tasks. These included the Clinical Evaluation of Language Fundamentals – Fourth Edition (Semel et al., 2003; *n*=5). Others included the Measure of Cognitive and Linguistic Abilities (Ellmo, 1995) (*n*=4), the PTBI (Hotz, Helm-Estabrooks, Nelson, & Plante, 2009) (*n*=2), the Functional Assessment of Verbal Reasoning and Executive Strategies (MacDonald & Johnson, 2005) (*n*=2), the Test of Narrative Language (Gillam & Pearson, 2004) (*n*=2), the Expression, Reception, and Recall of Narrative Instrument (Bishop, 2004) (*n*=1), the Test of Written Language (Hammill, 2009) (*n*=1), and the Renfrew Bus Story Test (Renfrew, 2010) (*n*=1).Other standardised tasks included the Montreal Evaluation of Communication (Joanette et al., 2015) (*n*=2), and the La Trobe Communication Questionnaire (Douglas, 2010) (*n*=1).

Thirty-three clinicians (63%) indicated the frequent or routine administration of non-standardised formal and informal tasks. Seven clinicians (14%) specifically identified the frequent or routine administration of published or self-generated discourse protocols. Six respondents (11%) indicated frequent or routine use of informal observation tools. One participant referred specifically to their use of the TBIBank database (MacWhinney et al., 2018). Twenty-five respondents (48%) reported frequent or routine administration of both non-standardised and standardised tools to assess discourse.

Intervention Methods for Spoken Discourse

Frequent or routine approaches to intervention were evenly distributed across counselling and education (*n*=21; 57%), direct cognitive intervention (*n*=20; 56%), social skills training, conversation skills training, communication partner training, and MSI (all *n*=19; 54%). See Figure 4. Fewer respondents identified frequent or routine implementation of oral narrative intervention and role play (both *n*=15; 43%), and a combined direct intervention of cognitive and discourse skills (*n*=9; 26%).

Genres and Outcome Measures in Discourse Assessment and Intervention

Conversational discourse was identified as a frequent or routine context of intervention by the majority of clinicians (*n*=45; 78%), followed by procedural (*n*=28; 53%), personal recount (*n*=26; 49%), narrative generation (*n*=22; 42%) and narrative retell (*n*=21; 40%), expository (*n*=15; 29%) and persuasive discourse (*n*=11; 20%).

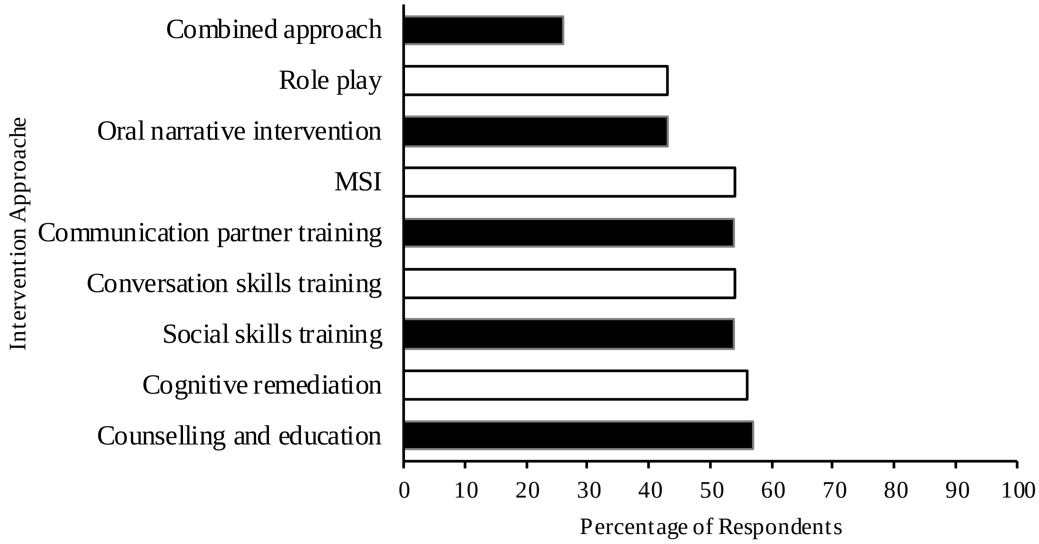

Figure 4. Intervention approaches implemented by SLPs for discourse in paediatric ABI.

A similar trend was observed for intervention. The majority of clinicians identified conversational discourse as the most frequent or routine context of treatment (*n*=26; 72%), followed by procedural discourse (*n*=22; %), narrative generation and retell, personal recount (all *n*=17; 46%), expository (*n*=16; 44%), and persuasive discourse (*n*=10; %). See Figure 5 for a comparison of context of assessment versus intervention.

The majority of clinicians (*n*=34; 64%) identified whole-level features such as story grammar as the most frequent or routine discourse measurements, followed by sentence-level features (*n*=18; 34%), such as mean length of utterance, and word-level features (*n*=6; 12%) such as lexical diversity. Four clinicians (8%) reported frequent or routine use of Correct Information Unit (CIU) analysis (Nicholas & Brookshire, 1993) to measure relevance and efficiency in discourse. One clinician (2%) reported frequent or routine use of software such as Systematic Analysis of Language Transcripts (SALT) (Miller, 2012).

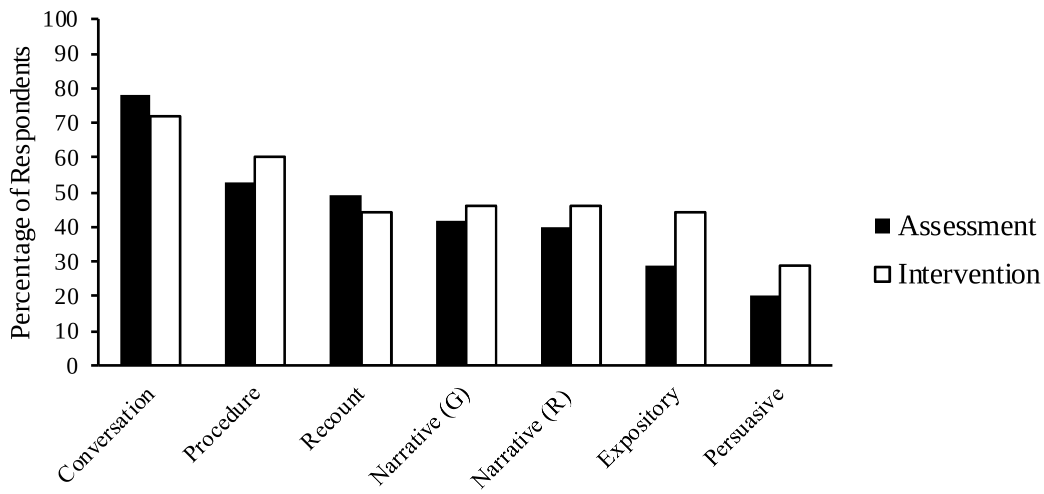

Figure 5. Genre contexts of assessment and intervention.

Non-Linguistic Factors Considered in Clinical Decision-Making

Respondents indicated frequent or routine consideration of executive function (*n*=38; 71%), attention (*n*=36; 67%), and memory (*n*=34; 65%), followed by IQ (*n*=25; 48%), Theory of Mind (*n*=13; 25%) and processing speed (*n*=6; 12%) during assessment planning. Clinicians also reported frequent or routine consideration of age at test (*n*=39; 73%), physical health (*n*=34; 64%), age at injury (*n*=33; 62%), and injury-related factors such as cause and chronicity (*n*=32; 61%). A smaller proportion frequently or routinely considered mental health, relevant communication contexts (both *n*=30; 56%), and family dynamic (*n*=25; 48%).

In intervention planning, the majority of clinicians indicated frequent or routine consideration of injury-related characteristics, age at test and injury and education (all *n*=30; 83%). Similar proportions reported frequent or routine consideration of executive function, cultural background, and physical health (all 71%) as well as family dynamic and communication partners (both *n*=26; 69%), attention (*n*=24; 67%), memory (*n*=23; 65%), and IQ (*n*=22; 63%). A smaller proportion frequently or routinely considered Theory of Mind (*n*=7; 20%), processing speed (*n*=4; 10%), and the client's relevant communication contexts (*n*=3; 9%). See Figure 6 for non-linguistic factors considered in assessment versus intervention.

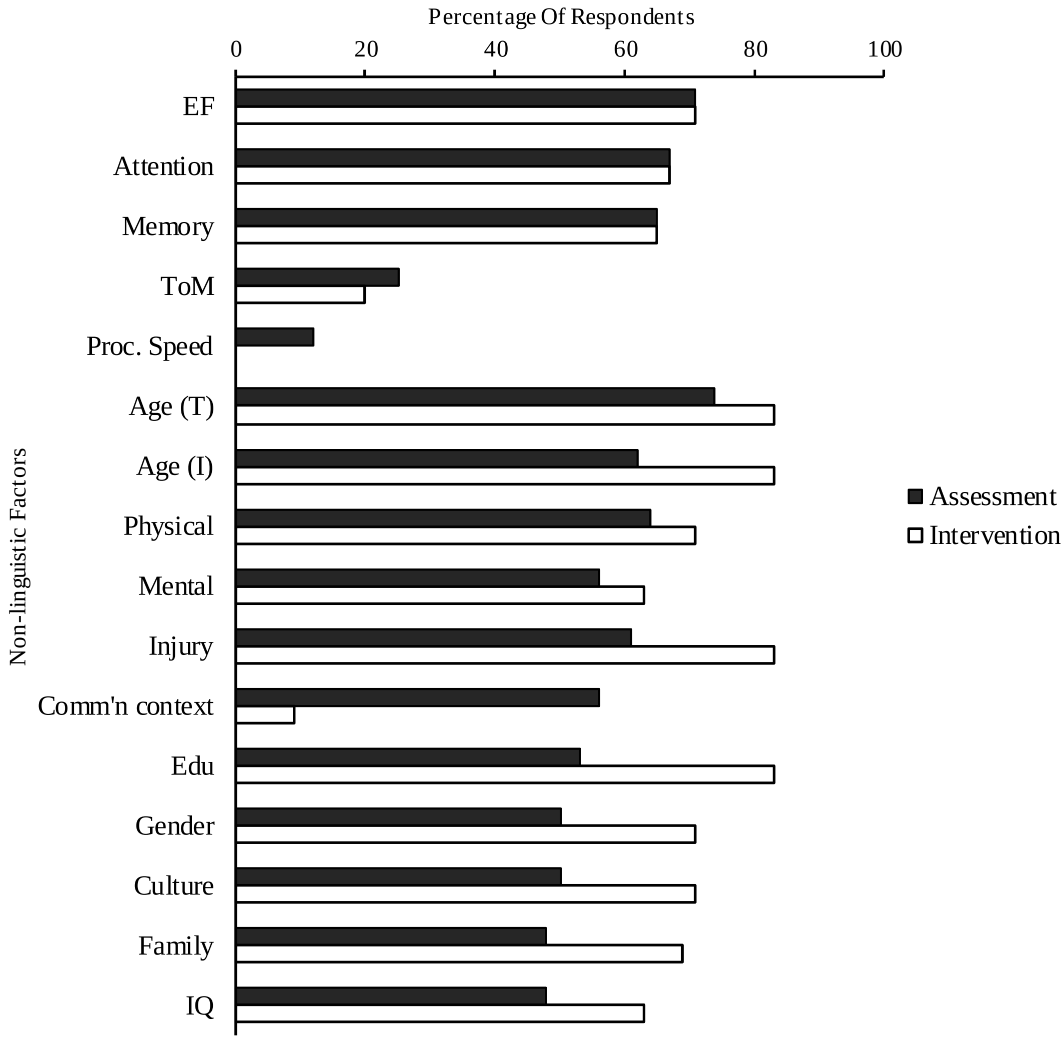

Figure 6. Non-linguistic actors frequently/routinely considered in assessment versus intervention planning.

Interdisciplinary Involvement in Assessment and Treatment Planning

During assessment planning, twenty-seven clinicians (50%) reported frequent or routine involvement of educational staff, followed by occupational therapists (*n*=25; 48%), psychologists (*n*=24; 45%), physiotherapists (*n*=22; 41%), psychiatrists, nurses (both *n*=7; 14%) and medical staff (*n*=6; 12%), and social workers (*n*=1; 2%). During intervention planning, 26 clinicians (72%) reported frequent or routine involvement of educational staff, followed by occupational therapists (*n*=16; 44%), psychologists (*n*=15; 42%), physiotherapists (*n*=6; 17%), medical staff (*n*=5; 14%), psychiatrists, nursing staff (both *n*=4; 11%), and social workers (*n*=2; 6%).

Attitudes Towards Discourse Assessment and Intervention

Thirty-five clinicians (98%) agreed that discourse assessment is valuable in clinical practice, and 32 (90%) agreed that it is important to assess discourse-level language across multiple genres. Twenty-three (64%) respondents agreed that they are confident in assessing discourse, while 14 (38%) agreed they are confident in analysing and interpreting the results of discourse assessment, and nine (26%) agreed that they are aware of assessment options available to them. Eighteen respondents (50%) agreed that they are aware of how the results of discourse assessment guide therapy planning. Twenty-two clinicians (61%) agreed that they are confident in treating and tracking change in discourse. Nineteen clinicians (54%) agreed that discourse intervention is successful, while 17 (46%) agreed that it generalises to untreated contexts.

Barriers and Facilitators to Clinical Practice for Discourse

Twenty-one clinicians (58%) selected the paucity of discourse assessment tools, evidence-based intervention approaches, and limited research and clinical recommendations. Others selected the lack of normative data for assessment (*n*=18; 51%) and intervention planning (*n*=17; 46%), as well as time (51%), comorbid cognitive impairments in assessment (*n*=12; 34%) and intervention (46%), and other assessment and treatment priorities (*n*=13; 37%). Facilitators to practice covered issues of funding (*n*=7; 20%), discourse research (*n*=6; 17%), including the interaction between cognitive and communication outcomes (*n*=1), translation of discourse assessment to intervention (*n*=4; 11%), training (11%), and advocacy for the role of speech pathology in paediatric ABI (*n*=4; 10%).

Use of Theory and Literature in Clinical Decision-making

Three clinicians (8%) identified the WHO ICF or ICF-CY (WHO, 2001; 2007), and four respondents (11%) identified MacDonald's (2017) model of cognitive-communication competence. Seven clinicians (19%) referred to literature on Story Grammar (Stein, 1979), and four clinicians (11%) to Blank's Levels of Questioning (Blank, 2002). Two respondents (6%) identified Baddeley and Hitch's (1974) memory model and theories of social-cognitive demand (Byom & Turkstra, 2012).

In terms of empirical literature, three respondents (8%) referred to Coelho's work on discourse assessment (e.g. Coelho, 2007), and others included Togher's studies of communication partner training (*n*=2, 6%) (Togher, McDonald, Tate, Rietdijk, & Power, 2016), and Ylvisaker's work in behavioural and social interventions (*n*=1, 3%) (Ylvisaker, Turkstra, & Coelho, 2005). Two clinicians (6%) referred to Snow's work in juvenile justice (Snow, 2008; Snow & Powell, 2005), and one clinician (3%) identified work by Levine and Cicerone in the area of cognition and neuropsychology (Cicerone, Levin, Malec, Stuss, & Whyte, 2006; Levine, Katz, Dade, & Black, 2002).

Research Priorities

The majority of respondents identified treatment efficacy studies as a high priority (*n*=30; 84%), followed by development of assessment protocols (*n*=24; 68%), normative data (*n*=20; 55%), and factors influencing discourse outcomes (*n*=19; 52%). Other research priorities included links between discourse and outcomes in psychosocial health (*n*=17; 48%) and cognitive function (*n*=16; 45%).

Discussion

This study aimed to identify current clinical practice for the assessment and treatment of discourse deficits in children and adolescents with a history of ABI in an international sample of SLPs. The relative dominance of respondents from Australia and New Zealand is not surprising given the Australian origin of the study and a key method of recruitment was snowball sampling of professional contacts and clinicians. The results indicated clinicians with a range of years of clinical experience were working with this population, from entry level to >25 years, though the dominance of more experienced respondents is likely reflective of the nature of paediatric ABI as a specialised area of clinical practice (Frith, Togher, Ferguson, Levick, & Docking, 2014; Turkstra et al., 2015). The finding that primary and secondary-school age clients were the most frequent group seen by SLPs is consistent with the frequent incidence of moderate to severe ABI in later childhood and into adolescence (Araki et al., 2017). This also corresponded with the literature reporting that students with ABI may not seek intervention until the academic, social, and environmental demands on diminished communication skills become unmanageable in later school years (MacDonald, 2017). The observation that respondents manage clients across a wide age range does underscore, however, the importance of understanding the nature and impact of discourse level impairments across childhood and adolescence.

Adherence to Clinical Recommendations

Discourse assessment. In contrast to previous research (Frith, 2014), the majority of clinicians in this study reported a preference for non-standardised and/or informal tasks to assess discourse skills. Clinicians who did report frequent use of standardised assessments identified those that are limited to a single genre (predominantly narrative) and assess lexical and grammatical language features alone such as the RBS (Renfrew, 2010) and the CELF-4 (Semel et al., 2003). These tools likely remain a frequent choice for clinicians due to their clear guidelines, availability of normative data, and translation to therapy goals, highlighting the need to establish these criteria within ecologically valid discourse assessments (Coelho et al., 2005). Generally, responses were largely consistent with current published guidelines that encourage the use of discourse assessment tools or observational checklists to detect weaknesses in higher-level everyday communication (Turkstra et al., 2005). Clinicians did not report the use of SALT (Miller & Iglesias, 2019) databases such as the use of the expository elicitation procedure and normative data published by Heilman and Malone (2014). As this survey was conducted in 2018, the use of more recent protocols such as the CUDP-A (Hill et al., 2020) or available normative data and elicitation protocols for persuasive discourse (Heilman et al., 2020) was not reflected in clinicians' responses. Ongoing research should monitor the translation of current literature and published protocols into clinical practice for this population. The more frequent administration of non-standardised tasks, however, does suggest a heightened awareness of the limitations of standardised methods. Clinicians opted for informal observation and behavioural checklists as well as self-generated discourse protocols and published protocols designed for adults with ABI. These results indicate there is a need for resources, such as TBIBank (Macwhinney et al., 2018), which are specifically designed for child and adolescent discourse, in order to enhance consistency in clinical practice and inform intervention planning. This is particularly important given the lack of appropriate assessment tools was identified as a considerable barrier to clinical practice.

The finding of infrequent discourse-level language targets for assessment was congruent with broader ABI and paediatric literature where there is a general preference for standardised assessment of word and sentence-level language skills (Ebert, 2014; Frith, 2014). While the assessment of word and sentence level behaviours is recommended for this population (CASLPO, 2018; Morgan et al., 2017), reliance on these results alone may lead to the under-identification of deficits in higher-level language required for daily communication (Coelho et al., 2005). Of interest was the finding that literacy was the least frequent assessment and intervention target. This finding was present despite the majority of clinicians treating primary and secondary school-age students, and research documenting long-term negative influence of paediatric ABI on literacy outcomes (Catroppa et al., 2009; Gennaro, 2010). This is also inconsistent with general recommendations in paediatric populations where literacy is a high priority due to its role in academic contexts, and risk of persistent academic difficulties in students with ABI (Catroppa et al., 2009; McLeod, Harrison, & Wang, 2019).

Discourse intervention. Unlike the clear preference for non-standardised assessment batteries, clinicians demonstrated no single preferred approach for discourse intervention. This reflects the equivocal evidence, or lack thereof, supporting discourse intervention in this population (Turkstra et al., 2015), which is a barrier to clinical practice. Generally, approaches incorporating language-based targets, such as oral narrative intervention (e.g. Glisson et al., 2019), were infrequently used despite being identified as treatment options for clients with ABI (Coelho, 2007), and being supported by literature directly referenced by surveyed clinicians (e.g. Stein & Glenn, 1979). Accommodation, social skills and conversation skills training, and communication partner training were infrequently implemented despite support in other clinical populations at risk of cognitive-communication deficits (Laugeson et al., 2012; Togher et al., 2013; Ylvisaker & Feeney, 2002). This reflects the paucity of literature supporting these approaches for discourse in paediatric ABI (Turkstra et al., 2015). In contrast, preferences for counselling and education, direct cognitive remediation, and MSI were in line with current recommendations for cognitive-communication in this population (Turkstra et al., 2015) despite no prior studies of interventions for discourse in paediatric ABI (Slomine & Locascio, 2009; Youse & Coelho, 2005).

The dominance of sentence-level targets for intervention was unsurprising as it is consistent with findings of assessment practices. However, although children and adolescents with ABI have shown reduced sentence complexity relative to non-injured peers (Ewing-Cobbs & Barnes, 2002; Reilly, Losh, Bellugi, & Wulfeck, 2004), there is little evidence to guide intervention at the sentence-level in this population (Turkstra et al., 2015). A closer inspection of responses indicated that clinicians who reported targeting discourse skills in intervention assessed word and sentence-level language more frequently than discourse skills. This could indicate that, in the absence of supporting evidence and assessment tools, SLPs formulate discourse-based therapy goals on the basis of word and sentence-level assessments. Given current guidelines advocate for discourse-level goals formulated on the basis of discourse assessment (Coelho, 2007; Morgan et al., 2017). This underscores the need for appropriate assessment tools for child and adolescent discourse, with accompanying normative data, in order to profile strengths and weaknesses and ecologically valid, discourse-level targets for intervention.

Genres and outcome measures in assessment and intervention. The genre in which discourse skills are measured is a critical consideration associated with discourse assessment and intervention planning (Moran et al., 2012). For children and adolescents, this means examining language skills in discourse tasks that reflect both social and academic interactions in the home, school, and community (Turkstra, 2000). The dominance of conversational discourse was consistent with the clinicians' preference for informal observation and behavioural checklists (such as the LCQ and the D-MEC; Douglas, 2010; Joanette et al., 2010), which enable profiling of discourse skills in the context of conversation. In contrast, the frequency of procedural discourse was given the lack of literature in this area, although this context is utilised in the assessment of people with aphasia (Pritchard, Dipper, Morgan, & Cocks, 2015; Ulatowska et al., 1981), and is described in educational resources relating to literacy development in school-aged children (Ministry of Education Western Australia, 2013). The relative infrequency of narrative as a context of discourse assessment was unexpected given its dominance in paediatric language literature, including studies of paediatric ABI (Biddle et al., 1996; Chapman, 1992; Chapman, 1997), and in theory surrounding discourse skills and its development (Bliss, McCabe, & Miranda, 1998; Liles, 1993; Stein, 1979). The infrequent incidence of expository and persuasive discourse in assessment and treatment was also not expected, given primary and secondary-school age children are increasingly exposed to these genres in academic settings (Nippold et al., 2008). This is also inconsistent with current recommendations to assess more complex genres, such as expository or persuasive discourse, to guide selection of therapy goals related to social and academic contexts (Coelho, 2007; Coelho et al., 2005; Nippold et al., 2008).

In contrast, findings were in keeping with current recommendations that encourage routine analysis of a range of word to whole-text language features across quality, quantity, and organisation of discourse skills (Coelho et al., 2005). There was a dominance of measures related to relevance, organisation, and structure of discourse over measures of word and sentence-level language features. This is consistent with the whole-text level of deficits typically observed in speakers with ABI (Coelho, 2007). Finding limited use of language analysis software is also consistent with language sampling practices across the broader paediatric literature, and may reflect a similar lack of awareness and training described in previous studies (Westerveld & Claessen, 2014). Similarly, there are few published protocols available to guide analysis of a range of genres and word to whole-text level language features in paediatric ABI. This provides further support for the development of assessment protocols for child and adolescent discourse to guide intervention planning.

A Biopsychosocial Approach to Clinical Practice

Given the emphasis on a holistic approach to clinical decision-making (MacDonald, 2017; Morgan et al., 2017), it was noteworthy that less than one quarter of respondents considered biopsychosocial frameworks in assessment and intervention planning. Clinicians did consider a range of non-linguistic factors in assessment and intervention planning, yet they more occurred at the level of Body Structure and Function than Activity and Participation or Environment/Context (WHO, 2007). At least two thirds of clinicians reported frequent assessment of cognitive functions, which suggest an awareness of the relationship between cognition and discourse deficits and the need to consider this in clinical decision-making (ASHA, 2003; CASLPO, 2018; Morgan et al., 2017). This is supported by clinicians' direct references to models of working memory and social-cognitive demand. Other physical and injury-related (e.g. lesion location) factors that are known to influence communication outcomes were also frequently considered (Catroppa & Anderson, 2004; Goldstein & Levin, 2001; Turkstra et al., 2015). In contrast, education, cultural and linguistic diversity, daily communication contexts, and family dynamics, which are key influencers over the success of interventions in ABI (Foster et al., 2012; Ryan et al., 2016), were considered less frequently. This is not consistent with ANCDS recommendations that assessments of cognitive-communication should routinely include "evaluation of the person's pre-injury characteristics, stage of development and recovery, communication-related demands of personally meaningful everyday activities and life and communication contexts" (Turkstra, Ylvisaker, Coelho, Kennedy, Sohlberg, & Avery 2005, p. xxxii). To guide the consideration of factors at the levels of Activities and Participation and Environment/Context, researchers are well placed to explore the link between discourse skills and broader psychosocial factors in paediatric ABI (WHO, 2001).

In line with current recommendations of collaborative practice (MacDonald, 2017), half of clinicians involved other disciplines in clinical decision-making, teachers being the most frequent (Turkstra et al., 2015). The infrequent involvement of professionals in the areas of neuropsychology and psychology was surprising given the potential for persistent cognitive and psychosocial deficits in paediatric ABI (Babikian & Asarnow, 2009; Elbourn et al., 2019). Despite this, respondents did refer to their use of interdisciplinary literature in the areas of juvenile justice, cognition, and neuropsychology (Aguilar et al., 2019; Chapman et al., 2001). This result may reflect limited access to a wide multidisciplinary team, or limited awareness of the role of other disciplines and need for collaborative practice in clinical decision-making in this population.

Clinical Implications

The results of this survey study have considerable implications for clinical practice in paediatric ABI. This study has identified current methods of assessment and intervention used for discourse in this population, including barriers to clinical practice to be addressed in future research. The results support continued emphasis on the consideration of a range of non-linguistic factors across Body Structure and Function, Context, and Activity and Participation domains in assessment and intervention planning (WHO, 2001). Inconsistencies in holistic approaches to clinical decision-making may reflect a lack of evidence supporting an association between discourse and non-linguistic factors in adolescents with and without ABI. Word and sentence-level behaviours remain the dominant target for assessment and intervention, likely given the availability of standardised language assessments for use to identify therapy targets and appropriate approaches. This highlights the considerable need for the development of appropriate child and adolescent discourse protocols with corresponding normative data to guide interpretation and formulation of intervention goals[6]. This would enable clinicians to select goals at the level of Activity and Participation that reflect communication competence in daily life, and may enable further treatment efficacy research. This is a priority given clinicians reported no one preferred approach to intervention; opting most frequently for counselling and education. Clinicians also experience barriers at the organisational level, such as lack of funding, education and training surrounding discourse assessment and intervention and (Frith, 2014; Westerveld & Claessen, 2014). These barriers may be mitigated by increased research into the nature and consequences of discourse in paediatric ABI, more appropriate and evidence-based assessment and intervention methods that allow clinicians to translate empirical recommendations in to everyday practice.

Limitations and Future Directions

The sample size of this study was smaller than others that have surveyed assessment and intervention practices in clinical populations (Frith, 2014; Westerveld & Claessen, 2014). We were not able to conduct statistical analysis of relationships among demographic factors and aspects of clinical practice (Frith, 2014). This would be a valuable direction for future research. Respondents were not questioned about the service delivery models of their country of practice, which may have had a considerable impact on clinical decision-making in this population. As this was an international survey, the potential cultural and linguistic limitations of the Likert scales used in this study is an important factor for consideration in future research (Lee, Jones, Mineyama, & Zhang, 2002). As in Frith (2014), potential subjectivity of Likert scales was counteracted by open-ended questioning where respondents could provide additional information. It is critical that ongoing attention be paid to the development of age-appropriate discourse assessment tools and normative data as

[6] This is addressed in Chapter 4 (Study 3) of this research program

this may facilitate more consistent clinical practice in the identification of impaired discourse and selection of intervention targets. Given that two thirds of respondents managed a mixed caseload in terms of client age, it is also important that data are collected cross childhood and adolescence. Enhanced understanding of discourse in this population will improve evidence-based practice. This includes its interaction with other domains of the ICF-CY (WHO, 2007), including Body Structure and Function factors such as cognition, but more importantly with the Activity and Participation domain and psychosocial factors. The most critical direction for ongoing research remains the development of discourse interventions that promote positive psychosocial outcomes following paediatric ABI.

Conclusions

Clinical recommendations and theoretical frameworks exist to guide intervention planning, yet supporting evidence is scant. Clinicians frequently assess discourse-level language in children and adolescents with ABI, albeit across a limited range of genres and outcome measurements. This underscores the need for age appropriate discourse assessment protocols and normative data to inform clinical decision-making. Clinicians also identified no one preferred approach to discourse intervention, which is consistent with the few existing treatment efficacy studies. Clinical practice was generally consistent with clinical recommendations; particularly selection of discourse-based targets for assessment and intervention to target competence at the level of Activity and Participation. Clinicians considered non-linguistic factors at the level of Body Structure and Function factors more frequently than other domains (WHO, 2007). Overall, clinical barriers were related to a restricted evidence base. The development of age-appropriate discourse assessment protocols and treatment efficacy studies that consider demographic, cognitive, and psychosocial factors are priority for future research in paediatric ABI.

General Conclusions of Part One of the Research Program

The interim objective of Part One was to scope the literature on discourse in adolescents with ABI, including links between discourse impairments and cognitive and psychosocial function, and to explore the nature of current clinical practice. The systematic review (Study 1), highlighted inconsistent methodology for discourse assessment and analysis across the existing literature, but a dominance for narrative discourse as a focus of studies in ABI. Similarly, the clinician survey (Study 2) also identified a preference for administration of standardised language batteries that assess narrative discourse, in response to potential uncertainty as to how best to assess other genres. The survey highlighted a dichotomy between clinicians' awareness of the value of discourse assessment and the availability of appropriate assessment tools that examined a range of language behaviours and discourse genre.

A key finding of Part One of the research program was the clear need for a wider range of elicitation and analysis protocols for assessment of adolescent discourse, alongside an increased awareness of the few protocols that currently exist to guide discourse assessment in this age group. These include the elicitation and scoring protocols and adolescent normative data for word and sentence-level measures available through SALT (Miller & Iglesias, 2019) for expository (Heilman & Malone, 2014) and, most recently, persuasive discourse assessment (Heilman et al., 2020). To enable sensitive and consistent assessment of adolescent discourse there is a need for additional standardised protocols that both set out an array of well-defined linguistic structures to measure and are accompanied by standardised scoring procedures to ensure consistency in administration. Furthermore, a standardised and reliable method to elicit and analyse adolescent discourse was required in order to achieve the main objective of this thesis and examine links between spoken discourse and cognitive and psychosocial domains of function.

In response, Part Two of the research program aimed to address the current paucity of assessment tools and normative data available for adolescent discourse, and limited understanding of what is expected of discourse in adolescents without ABI. The outcomes of Studies 3 and 4 inform discourse assessment and selection of appropriate targets to maximise the success of discourse-based intervention in clinical populations. The results also inform subsequent empirical studies of this research program.

PART TWO

Addressing the Issue of Assessment of Adolescent Discourse

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Chapter 4
Development of the CUDP-A and Profiling Adolescent Discourse

Chapter Overview

The current chapter presents a published empirical study involving the development of a dedicated tool for the assessment of everyday adolescent discourse and the collection of a large sample of reference data across micro-linguistic to super-structural language features[7] (Study 3). This study also examines the age- and gender-related differences in discourse skills in adolescence, and an exploration of links between spoken discourse skills and performance on a gold-standard assessment of oral language skills. The reference data on adolescent discourse obtained in this study is also used in subsequent studies in this thesis (Studies 4 to 6).

This chapter presents an Accepted Manuscript version[8] of an article entitled, '*Profiling variability and development of spoken discourse in mainstream adolescents',* published by Taylor & Francis Group in Clinical Linguistics and Phonetics on 3/03/2020, available online: http.www.tandfonline.com/10.1080/02699206.2020.1731607. The formatting of this study (headings, tables, etc) has been adapted to align with the larger thesis document. As this is an Accepted Manuscript, there is some repetition of key literature and theory that has been reviewed in previous chapters, although every attempt has been made to minimise this.

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[7] Coelho's (2017) classification: micro-linguistic (within sentence), micro-structural (across sentence); macro-structural (between sentence), and super-structural (whole-text).

[8] Copyright permission letters of approval are provided in AppendixC

Abstract

Background: Competence in spoken discourse is an important consideration during assessment and intervention planning for adolescents with communication difficulties. Currently, a lack of age-appropriate protocols and reference data against which to interpret performance, are barriers when working with this population, particularly those that assess a range of genre and language features.

Method: Using a new assessment tool, the Curtin University Discourse Protocol-Adolescent (CUDP-A), this study aimed to collect and describe spoken discourse samples from a large group of adolescents (n = 160), aged 12 to 15 years, recruited to represent a mainstream academic cohort. For each participant, samples of recount (n=3), expository (n=3), persuasive (n=3), and narrative (n=2) discourse were described using theoretically supported measurements sensitive to micro-linguistic, micro-structural, macro-structural, and super-structural discourse features. Participants also completed a standardized assessment of oral language.

Results: Variability was found in micro-linguistic and micro-structural features, with stability seen in macro-structural and super-structural features. Few age- and gender-related differences were observed, while multiple significant correlations between spoken discourse and oral language variables were revealed across the sample.

Conclusions: The CUDP-A was successful in eliciting spoken discourse across genres relevant to social and academic contexts, enabling an in-depth description of adolescent discourse. This tool, supported by the reference data, provides a new opportunity to assess spoken discourse skills in adolescents from clinical populations, e.g. acquired brain injury or developmental disorders. Further research is needed to examine factors influencing discourse ability, such as those that may be related to genre, or contextual factors related to the presence of communication partners, with novel tools such as the CUDP-A facilitating this.

Introduction

Competent communication skills are imperative to navigate through adolescence. Adolescents draw on oral discourse skills, in particular, to form and maintain friendships, participate wholly in and outside of the classroom, and develop their identity via communication of their thoughts, feelings, and opinions (Turkstra, 2000). Discourse-based assessment provides insight into adolescents' ability to meet these demands (Miller et al., 2016). In analysing discourse samples, clinicians gain insight into the dynamic interaction that occurs between cognition, world knowledge, knowledge of discourse structures, and skills in lexical retrieval and phonological and morpho-syntactic encoding, as is described in models of discourse planning (e.g. Frederiksen & Stemmer, 1993). Furthermore, clinicians can garner valuable information about potential, real-world, activity limitations and participation restrictions experienced by adolescents with communication difficulties, in line with the World Health Organisation's (WHO) children and youth version of the International Classification of Functioning, Disability, and Health framework (ICF-CY; WHO, 2007). Together, this underscores the importance and value of assessing real-world communication skills using discourse-based tasks; particularly given established links between ineffective communication and reduced psychosocial health including social participation, academic and vocational outcomes, and rates of youth offending in adolescents (Miller, Andriacchi, & Nockerts, 2016; Snow, 2005). As such, persistent difficulties with discourse production can have a significant impact on many clinical populations, such that timely assessment of discourse skills is a priority for speech-language pathologists. Currently, however, routine assessment of adolescent discourse is limited by a paucity of age-appropriate, standardised, assessment protocols that guide elicitation and analysis of adolescent discourse across multiple genres that reflect daily communication demands. Current practice is also influenced by a limited understanding of what is expected of adolescents across these genres within a mainstream population.

Between child- and adulthood, spoken discourse is associated with continued development in lexical diversity and syntactic length and complexity (Channell, 2015; Heilmann, 2010; Westerveld & Moran, 2011). Researchers have also documented little variability in word and sentence-level discourse features on the basis of gender (Channell, 2015; Nippold, Vigeland, Frantz-Kaspar, & Ward-

Lonergan, 2017), yet few studies have examined age and gender-related differences in discourse features above the level of the sentence in this age group. This has resulted in a limited understanding of the nature and variability of a range of discourse-based language features within the adolescent population in general (Bornstein, 2014; Lundine et al., 2018; Nippold, 2005). In many school-age clinical populations, such as those with ABI and ASD, discourse assessment is encouraged due to its relevance to daily interaction and psychosocial wellbeing (Lê et al., 2011; Solomon, 2004). Given 'the very definition of disordered depends upon the understanding of normality and normal variation' (Hollands, 1990, p.37), limited understanding of the characteristics and variability of discourse within a mainstream adolescent population has considerable impact when working clinically with this age group. This highlights the importance of examining these features using standardised methods as a means to better evaluate difficulties that may manifest in the spoken discourse of adolescent clients.

Clinical Assessment of Adolescent Discourse

In the absence of published protocols and reference data specific to the assessment of adolescent discourse, speech-language pathologists have needed to draw on traditional language batteries, where standardized administration procedures and guidelines for interpretation and goal selection, as well as age-appropriate normative data are available (Hollands, 2005; Paul & Norbury, 2011). Discourse-level impairments can, however, be subtle in nature, and go unidentified by traditional language tasks that stereotypically assess word and sentence-level features. As a result, proponents of discourse assessment encourage clinicians to supplement these tasks with ecologically valid discourse-based tasks (Ebert, 2014). Despite this, few published protocols are available to inform the choice of genres, elicitation tasks, or analyses suitable for adolescents, nor to provide details about expected levels of performance.

Previous studies have sought to describe profiles of adolescent discourse to help clinicians working with this age group (Channell et al., 2018; Heilmann & Malone, 2014; Nippold M, 2014; Nippold et al., 2017). The majority of past studies describe assessment and analysis methods and provide normative data on one or two monologic genres such as narrative and expository discourse. Across academic and social environments, adolescents are required to produce narrative-based genres such as personal recount and fictional storytelling, alongside fact-based expository and persuasive genres (Berman & Nir-Sagiv, 2007; SCSA, 2016). Expository discourse involves the use of language to convey information about a topic, and persuasive discourse involves the use of language to convey an opinion and argue a point (Nippold, 2007; Nippold & Scott, 2010; Turkstra, 2000). Both expository and persuasive discourse are crucial for academic (e.g. classroom debates, oral presentations) and social (e.g. persuading friends to go out for dinner) situations in adolescence. In addition, expository and persuasive discourse is involved in the development of self-identify and expression of values, morals, and opinions that occurs at this age (Turkstra, 2000).

The transition to these more complex, adult-like discourse forms that are required across academic and social environments may be apparent only when "sophisticated linguistic phenomena are analysed" (Nippold, 1998, p.3) within tasks that reflect daily communication demands. The majority of existing adolescent discourse literature provides normative data for predominantly word and sentence-level features such as productivity, fluency, lexical diversity, and morpho-syntactic complexity with limited description of more complex discourse features such as organisation and topic management (Berman & Nir-Sagiv, 2007; Nippold et al., 2008; Scott & Windsor, 2000; Westerveld, 2004, 2016). Variables used to analyse discourse features can be broadly categorised into micro-linguistic (within-sentence, e.g., productivity, syntactic complexity), micro-structural (across-sentence, e.g., analyses of cohesion), macro-structural (between-sentence, e.g., coherence), and super-structural measures (whole-text, e.g., story grammar), a framework set out by Coelho (2007). Support for a comprehensive analysis of behaviours above the micro-linguistic level in particular comes from the need to identify a range of strengths and weaknesses in discourse within clinical populations. This is particularly critical for those with higher-level, cognitive-communication disorders that are characterised by deficits in more complex language features (Lê et al., 2011).

A comprehensive discourse assessment should therefore include micro-linguistic to super-structural measures appropriate to the complexities of adolescent discourse that capture skills across the multiple genres required by the range of communicative contexts encountered at this age (Miller et al., 2016). To do so, however, clinicians are expected to consult a wide range of studies with varying methodology in order to inform selection of genres, elicitation tasks, and outcome measurements. This process may be particularly challenging, given the time taken to identify, adapt, and modify the protocols and normative data provided in existing literature has been identified as a considerable barrier to discourse assessment in clinical practice (Bryant, Spencer, & Ferguson, 2017; Coelho et al., 2005). An age-appropriate protocol that provides consistent and standardised instructions for elicitation and scoring of adolescent discourse across multiple genres and discourse features may mitigate these difficulties associated with discourse assessment (Coelho, 2007).

The Current Study

The aim of the current study was to develop a dedicated protocol to assess adolescent discourse, using standardized elicitation and scoring procedures, and to collect a reference data sample to identify variation within clinical populations. Drawing on the elicitation framework and analysis principles of the Curtin University Discourse Protocol (CUDP), developed for the adult population (Whitworth et al., 2015). The Curtin University Discourse Protocol – Adolescent version (CUDP-A) was developed to provide insight into spoken discourse skills of adolescents between the ages of 12 and 15. The adult tool has been shown to demonstrate good to excellent stability across both micro- and macrostructures, and good-moderate stability in communicative informativeness and efficiency, in healthy adult speakers (Whitworth et al., 2018), and good to excellent stability has also been seen in adult clinical populations (Beales et al., 2018). In adapting and extending the adult tool, the genres of the CUDP were modified to reflect those commonly encountered by adolescents in academic and social contexts, and scoring procedures were expanded to incorporate measures sensitive to micro-linguistic, micro-structural, macro-structural, and super-structural discourse features (Coelho, 2007; SCSA, 2016). This study also aimed to examine age- and gender-related differences in performance on the CUDP-A and to relate spoken discourse skills to performance on a traditional, standardized assessment of oral language.

Method[9]

Participants and Procedure[10]

One-hundred and sixty adolescents (male = 72; female = 88) aged between 12 and 15 (*M*=13; 1, *SD*=1; 1) were recruited from secondary-schools in Perth and via snowball sampling. Attendance at mainstream school and English as their first language were the primary inclusion criteria. Language spoken in addition to English included Azari, Farsi, Japanese, and Spanish (each *n*=1). Exclusion criteria included a diagnosis of intellectual disability, neurological disorder, and/or ASD. A history of speech pathology intervention was not an exclusionary factor, providing the above criteria were met. The sample was purposefully recruited to reflect the potential range of language and communication abilities encountered within a mainstream academic classroom in Western Australia. Twenty-eight participants had a history of intervention for articulation/intelligibility (*n*=18), phonological awareness (*n*=2), stuttering (*n*=6), and literacy (*n*=2). All participants were administered the CELF-4 (Semel et al., 2003) to obtain a Core Language Score. All participants obtained a Core Language Score (CLS) greater than 80 indicating no presence of language disorder or delay (Semel et al., 2003).

Materials

Curtin University Discourse Protocol – Adolescent. The CUDP-A was used to elicit eleven discourse samples across recount (n=3; e.g. 'What did you do on the weekend?'), expository (informative; n=3; e.g. 'What is social media?'), persuasive (n=3; e.g. 'Should sport be compulsory at school and why?'), and fictional narrative (n=2). Two Norman Rockwell paintings, 'The Young Lady with the Shiner' (Rockwell, 1953) and 'The Runaway' (Rockwell, 1958), were stimuli for the narrative tasks. Norman Rockwell paintings were selected based on their use in previous research of discourse in clinical and non-clinical populations (Cannizzaro & Stephens, 2019; Coelho et al., 2005). Paintings containing younger subjects were chosen specifically, as the relevance of Norman Rockwell stimuli has been

[9] This is a published manuscript. For the interest of examination, the reader is directed to Appendix A for additional information on the methodology underpinning Part Two of this research program.

[10] Ethics approval obtained from Curtin University (HRE2016-0219), Catholic Education Western Australia (RP2017/31), and Department of Education Western Australia (D18/0182330)

questioned for studies of younger participants (Steel & Togher, 2019). Participants were provided with verbal question-style prompts and alternative questions were available where topics were unfamiliar to the speaker. The complete CUDP-A script is provided in Appendix F.1.

Transcription and coding. Responses were audio-recorded and transcribed into Systematic Analysis of Language Transcripts Research Version (SALT; Miller & Inglesias. 2018). Samples were segmented into Communication Units (c-unit; Loban, 1976), and coded using standard SALT coding conventions and study-specific measures (see Appendix F.2 for CUDP-A scoring protocol). Samples were coded using measures across Coelho's (2007) four levels of analysis: micro-linguistic, micro-structural, macro-structural, and super-structural.

Micro-linguistic features. Micro-linguistic variables measured within-sentence discourse features including productivity, fluency, lexical diversity and syntactic complexity (Coelho, 2007). Productivity was measured in total c-units (Loban, 1976). Fluency was measured using total maze words and percent maze words. Lexical diversity was measured using the number of different words (Miller & Iglesias, 2018). Morpho-syntactic complexity was indexed using mean length of utterance in words (MLUw). Clausal density was calculated by dividing total clauses by total c-units (Nippold, 2010).

Micro-structural features. Micro-structural variables measured across-sentence features including the frequency and adequacy of referential cohesion. Frequency was calculated as total number of demonstrative ties, personal and possessive pronouns and determiners (Liles, 1985). Each referential tie was judged as complete, incomplete, or erroneous using Liles' (1985) procedure. Ties were complete if the referent was easily located in preceding utterances, incomplete if it was not provided or was not evident from context, or erroneous if it was incorrect or ambiguous (Liles, 1985). Adequacy was calculated by dividing the number of complete ties by the total ties.

Macro-structural features. Macro-structural variables measured between-sentence features including coherence, relevance, and efficiency (Coelho, 2007). Local and global coherence was assessed using Glosser and Deser's (1990) rating scales, where higher ratings indicated better coherence. An average local and global coherence rating was calculated for each sample. Nicholas and Brookshire's (1993) Correct Information Unit (CIU) analysis was used to generate a measure of relevance in percent CIU (%CIU) and efficiency in CIUs per minute (CIUpm).

Super-structural features. Super-structural variables measured text-level by tallying the number of schema components in each genre. Schema components were identified for each genre based on theory (Stein, 1979) and resources from the Western Australian curriculum (SCSA, 2016). For recounts and narratives, components included: orientations to 'character', 'setting', 'time', and 'other'; initiating event; response; events; and elaborations. Narratives also included reflective comments. For expositions, these included: thesis; sub-category; and elaborations. For persuasive discourse samples were coded for: supporting argument; counter-argument; and elaborations. All samples were also coded for conclusions and end markers, as well as schema deviations (missing components), order deviations, restatements of question, and genre shifts.

Reliability. Ten percent of samples were checked for reliability of transcription and SALT coding by two independent final-year Speech Pathology students. Two experienced speech-language pathologists re-coded 10 percent of samples; disagreements were discussed, and the protocol updated where necessary. Intra-class correlation coefficients based on a mean rating, consistency, two-way random effects model and analysis of percent agreement were calculated (Koo, 2016).

Clinical Evaluation of Language Fundamentals – Fourth edition. Expressive and receptive language skills were measured using the CELF-4 (Semel et al., 2003). The CELF-4 is a widely used, standardized, assessment of oral language skills normed on an American standardization sample of 2650 children, adolescents, and young adults aged 5 to 21 years (Semel et al., 2003). Each participant received a CLS, which reflected their performance on five subtests: Concepts and Following Directions, Recalling Sentences, Formulated Sentences, Word Classes, and Word Definitions (Semel et al., 2003). The CLS was used as a test for the presence of language disorder or delay.

Statistical Analysis

Measures of central tendency and spread were used to describe performance on the CUDP-A. To examine the effect of age and gender on discourse measures, data were separated into groups as follows: 12;0-12;11 (n=33), 13;0-13;11 (n=50), 14;0-14;11 (n=39), and 15;0-15;11 (n=38), and male (n=72) and female (n=88). Multivariate analyses of variance (MANOVA) were conducted to examine the effect of age and gender on CUDP-A variables. Follow-up univariate tests are reported when significant. To avoid risk of Type One error, a Bonferroni corrected alpha was applied to analyses of age effects (p=0.0125; .05/4). Assumption testing revealed satisfaction of homogeneity of variance. Normality was not observed at all levels of the independent variables due to extreme scores (Tabachnik & Fidell, 2007), however, ANOVAs are robust to non-normal distributions when sample sizes $N \geq 30$ (Daniel, 1999)[11]. Outliers were deemed representative of potential variability in performance. A series of Pearson correlations were conducted to examine the association between discourse measures, and between discourse and CELF-4 Core Language Scores. Effect sizes and correlation coefficients were interpreted according to Cohen's conventions (1988).

Results

Inter-Rater Reliability of the CUDP-A

Agreement was 98% to 99% between the original transcription and independent raters. Intra-class correlation coefficients revealed good to excellent reliability for micro-linguistic (0.96 to 0.98), micro-structural (0.95 to 0.99), macro-structural (0.76 to 0. 99), and super-structural measures (0.90; Koo & Mae, 2016).

Performance on the CUDP-A

Descriptive statistics for each age groups are reported in Tables 8 to 11, and in Table 12 and Table 13 across gender groups. The coefficients of set out the ratio of the standard deviation to the mean (in %) and allow comparison of variability across different units of measurement. Coefficients of variation are not provided for super-

[11] Four permutations of data were analysed (transformed (log10[x+1] and untransformed data sets including and excluding outliers) to determine the effect outliers (Tabachnik & Fidell, 2007). Effect sizes and main effects were consistent across data sets. Therefore, results of untransformed data including outliers are reported.

structural measures as this measure is not accurate with means close to zero (Visscher, Hill, & Wray, 2008).

Age differences. The MANOVAs revealed no significant effect of age on micro-linguistic, $F(18, 459) = 1.052$, $p=0.400$, $\eta_p^2 = 0.04$, micro-structural, $F(6, 312) = 1.905$, $p=0.080$, $\eta_p^2 = 0.04$, or macro-structural discourse features $F(12, 465) = 1.127$, $p=0.336$, $\eta_p^2 = 0.03$. As each genre consisted of a unique super-structure, MANOVAs were conducted for each genre to examine age-effects. Analyses revealed no effect of age on super-structure in recount, $F(39, 438) = 1.267$, $p=0.136$, $\eta_p^2 = 0.1$, though univariate analyses revealed a significant effect for Orientations to Time, $F(3, 156) = 4.384$, $p=0.005$, $\eta^2 = 0.078$. The 15-year-old group produced significantly more than the 13 year-old group, $p =0.007$. Multivariate analyses revealed no effect of age on super-structure in expositions, $F(30, 447) = .940$, $p=.560$, $\eta_p^2 = .06$, or persuasive samples, $F(33, 440) = 1.202$, $p=0.208$, $\eta_p^2 =0.08$. Finally, multivariate analysis revealed no age-related differences in narrative super-structure, $F(39, 438) = 1.170$, $p=0.229$, $\eta_p^2 =0.09$, yet follow-up analysis, showed an effect for total Conclusions, $F(3, 156) = 4.520$, $p=0.005$, $\eta^2 = 0.080$. The 15 year-old group produced more than the 14 year-old group, $p=0.002$.

Gender differences. No gender differences were observed across micro-linguistic, $F(6, 153) = 2.034$, $p=0.064$, $\eta_p^2 = 0.07$, micro-structural features, $F(2, 157) = .884$, $p=0.415$, $\eta_p^2 = 0.01$, or general super-structural measures $F(4,155) = 1.152$, $p=0.334$, $\eta_p^2 = .03$. Groups differed at the macro-structural level, $F(4, 155) = 3.272$, $p=0.013$, $\eta_p^2 = 0.08$, where female participants obtained higher average ratings of global coherence across genres $p=0.004$. An effect of gender was also observed for genre-specific variables in expositions, $F(10, 149) = 5.047$, $p<0.001$, $\eta_p^2 = .25$. Females produced more sub-categories, $p<0.001$ and fewer schema deviations, $p=0.001$ than male participants, and males produced more end features, $p<0.001$. No other significant differences were observed.

Table 4.1
Descriptive statistics (mean, standard deviation, and coefficient of variation in percent) for micro-linguistic variables across age groups and genres.

		Recount			Exposition			Persuasive			Narrative			All		
CUDP-A variable	Age	*M*	*SD*	CoV	*M*	SD	CoV	*M*	*SD*	CoV	*M*	*SD*	CoV	*M*	*SD*	CoV
Total c-units	1	39.8	43.1	108.3	21.1	23.6	111.6	24.0	14.3	59.6	33.8	28.1	83.1	118.9	91.7	77.1
	2	46.0	44.7	97.13	25.3	20.3	83.8	30.2	20.3	67.2	34.7	29.6	85.3	136.2	97.8	71.8
	3	31.7	31.9	100.9	18.9	14.6	77.6	25.9	22.5	86.9	27.2	17.1	62.9	103.5	67.5	65.2
	4	44.2	40.2	91.0	21.3	13.2	62.1	30.9	28.2	91.3	41.3	40.5	98.1	137.6	96.1	69.8
	All	40.7	40.5	99.5	21.7	18.3	84.8	28.0	22.0	78.6	34.3	30.1	87.8	124.9	90.9	72.8
NDW	1	119.2	75.6	63.4	83.7	52.8	63.1	104.5	40.1	38.4	134.7	63.5	46.2	442.2	197.5	46.7
	2	139.2	86.5	62.2	96.4	59.2	61.4	119.7	55.3	46.2	134.0	80.2	59.9	489.3	246.2	50.3
	3	102.0	64.1	62.9	78.9	50.1	63.4	103.3	64.0	62.0	121.1	56.6	46.7	405.3	192.6	47.5
	4	135.3	88.7	65.5	97.7	48.4	49.6	127.3	65.4	51.4	149.3	78.9	52.8	509.7	232.9	45.7
	All	125.1	60.5	64.4	89.8	53.4	59.5	114.4	57.8	50.5	134.6	71.5	53.1	463.9	221.9	47.8
Total Mazes	1	22.2	37.6	169.3	15.6	25.9	165.9	16.7	14.9	89.2	13.1	17.1	130.5	67.7	82.1	121.3
	2	21.6	21.5	99.7	17.8	16.6	93.3	19.7	16.3	82.7	13.4	15.6	116.4	72.5	60.3	83.2
	3	15.7	17.4	110.3	15.6	13.2	85.0	18.3	20.1	109.8	12.2	18.1	148.4	61.8	55.9	90.5
	4	25.4	28.5	112.3	19.7	13.2	66.9	24.8	28.0	112.9	20.5	28.5	139.0	90.4	77.1	85.8
	All	21.2	26.5	125.0	17.2	17.5	101.3	20.0	20.4	102.0	14.7	20.3	138.1	73.1	68.7	93.9
%Maze words	1	9.2	4.8	51.6	12.4	7.9	64.2	10.2	5.0	49.0	6.7	5.9	88.1	9.6	4.5	46.9
	2	8.7	4.5	51.4	12.9	6.2	47.8	10.3	5.0	48.5	6.3	3.9	61.9	9.5	3.9	41.1
	3	9.3	4.7	50.8	14.9	7.6	51.1	10.9	4.7	43.1	6.1	5.8	95.1	10.3	4.4	42.7
	4	10.1	4.7	46.5	13.9	5.7	40.9	10.9	6.5	59.6	6.6	4.0	60.6	10.3	4.4	42.7
	All	9.3	4.6	49.9	13.5	6.8	50.5	10.6	5.3	50.0	6.4	4.8	75.0	9.9	4.2	42.4
MLUw	1	7.5	1.1	14.2	8.6	1.9	22.4	10.5	2.1	20.0	10.3	1.7	16.5	9.2	1.0	10.9
	2	8.1	1.2	15.1	8.4	1.8	20.8	10.5	2.2	20.9	10.1	2.1	20.8	9.2	1.1	12.0
	3	7.5	1.6	20.8	8.3	1.9	23.3	10.1	2.3	22.8	10.7	2.6	24.3	9.1	1.2	13.2
	4	8.0	1.1	13.8	9.2	1.9	21.0	11.6	3.0	25.9	10.5	2.4	22.9	9.8	1.5	15.3
	All	7.8	1.3	16.3	8.6	1.9	22.0	10.7	2.5	23.4	10.3	2.2	21.4	9.3	1.3	14.0

Table 4.1

Descriptive statistics (mean, standard deviation, and coefficient of variation in percent) for micro-linguistic variables across age groups and genres.

		Recount			Exposition			Persuasive			Narrative			All		
CUDP-A variable	Age	*M*	*SD*	CoV	*M*	SD	CoV	*M*	*SD*	CoV	*M*	*SD*	CoV	*M*	*SD*	CoV
Clausal density	1	1.1	.3	23.4	1.4	.3	21.4	1.7	.5	29.4	1.3	.2	15.3	1.4	.2	7.7
	2	1.2	.2	13.0	1.3	.2	14.6	1.6	.4	25.0	1.3	.1	7.7	1.3	.1	7.7
	3	1.1	.2	13.2	1.3	.2	18.5	1.6	.3	18.8	1.3	.2	15.4	1.3	.1	7.7
	4	1.1	.2	17.8	1.3	.3	23.8	1.7	.5	29.4	1.4	.4	28.6	1.4	.2	7.7
	All	1.1	.2	17.0	1.3	.3	20.0	1.6	.4	25.0	1.3	.2	15.3	1.3	.1	7.7

Note: CoV interpreted as <10% low, >20% high, and >30% very high variability (Pimentel-Gomes, 1985). Age: 1 = 12 year-olds; 2 = 13 year-olds; 3 = 14 year-olds; 4 = 15 year-olds.

Table 4.2

Descriptive statistics (mean, standard deviation, and coefficient of variation in percent) for macro-structural variables across age groups and genres.

		Recount			Exposition			Persuasive			Narrative			All		
Measure	Age	*M*	*SD*	CoV	*M*	*SD*	CoV	*M*	*SD*	CoV	*M*	*SD*	CoV	*M*	*SD*	CoV
Total referential ties	1	23.4	26.3	112.4	11.2	12.7	113.4	14.5	10.2	70.3	28.8	24.4	84.7	77.9	60.0	77.0
	2	29.3	28.8	94.3	16.4	15.5	94.5	21.6	14.5	67.1	32.8	25.4	77.4	99.9	73.1	73.2
	3	17.1	20.1	117.5	11.7	11.5	98.3	16.7	14.6	87.4	23.3	15.3	65.7	68.9	45.8	66.5
	4	30.0	36.6	122	15.8	14.8	93.7	25.8	23.1	89.5	39.1	32.8	83.9	110.6	82.3	74.4
	All	25.3	28.9	114.2	14.0	13.9	99.3	19.9	16.7	83.9	31.1	25.7	82.6	90.4	68.8	76.1
Cohesive adequacy %	1	61.6	20.4	33.1	68.1	30.6	44.9	55.7	26.2	47.0	91.8	15.7	17.1	69.3	14.2	20.5
	2	65.7	23.9	36.4	62.3	32.1	51.5	58.3	26.4	45.1	92.5	13.0	14.1	69.7	16.4	23.5
	3	59.1	24.1	40.8	56.7	37.9	66.8	50.3	30.9	61.4	88.6	23.2	26.2	63.6	20.0	31.4
	4	63.7	29.6	46.5	66.7	33.9	50.8	55.3	27.5	49.7	90.9	14.5	15.9	69.1	15.6	22.6
	All	62.8	24.7	39.3	63.2	33.7	53.3	55.1	27.8	50.4	91.0	16.8	18.5	68.0	16.8	24.7

Note: CoV interpreted as <10% low, >20% high, and >30% very high variability (Pimentel-Gomes, 1985). Age: 1 = 12 year-olds; 2 = 13 year-olds; 3 = 14 year-olds; 4 = 15 year-olds.

Table 4.3

Descriptive statistics (mean, standard deviation, and coefficient of variation in percent) for macro-structural variables across age groups and genres.

		Recount			Exposition			Persuasive			Narrative			All		
Measure	Age	*M*	*SD*	CoV	*M*	*SD*	CoV	*M*	*SD*	CoV	*M*	*SD*	CoV	*M*	*SD*	CoV
Coherence Local coherence	1	3.9	0.5	12.8	3.6	0.6	16.7	3.9	0.5	12.8	4.3	0.4	9.3	4.0	0.3	7.5
	2	3.9	0.3	7.7	3.7	0.8	21.6	3.8	0.5	13.2	4.3	0.5	11.6	3.9	0.4	10.3
	3	4.0	0.5	12.5	3.5	1.0	28.6	3.8	0.5	13.2	4.2	0.5	11.9	3.9	0.5	12.8
	4	3.8	0.4	10.5	3.8	0.6	15.8	3.8	0.5	13.2	4.1	0.5	12.2	3.9	0.4	10.3
	All	3.9	0.4	10.3	3.6	0.8	22.2	3.8	0.5	13.2	4.2	0.5	11.2	3.9	0.4	10.3
Global coherence	1	4.3	0.5	11.6	4.1	0.5	12.2	4.4	0.4	9.1	4.8	0.2	4.2	4.4	0.3	6.8
	2	4.3	0.4	9.3	4.2	0.6	14.3	4.4	0.4	9.1	4.8	0.3	6.3	4.4	0.3	6.8
	3	4.3	0.4	9.3	4.1	0.6	14.6	4.2	0.5	11.9	4.7	0.4	8.5	4.4	0.4	9.1
	4	4.2	0.4	9.3	4.4	0.5	11.4	4.4	0.5	11.4	4.8	0.2	4.2	4.5	0.3	6.7
	All	4.3	0.4	9.3	4.2	0.6	14.3	4.4	0.5	11.4	4.8	0.3	6.3	4.4	0.3	6.8
Relevance % CIU	1	78.0	9.0	11.5	78.0	9.4	12.1	82.9	6.8	8.2	86.8	7.5	8.6	81.4	5.9	7.2
	2	80.2	7.0	8.7	78.9	8.9	11.3	83.1	6.2	7.5	84.9	7.0	82.4	81.8	5.0	6.1
	3	79.6	7.5	9.4	75.7	12.4	16.3	80.5	8.5	10.6	85.3	10.6	12.4	80.3	7.2	9.0
	4	76.8	7.7	10.0	77.5	8.6	11.1	81.0	9.9	12.2	85.3	6.8	8.0	80.1	6.8	8.5
	All	78.8	7.8	9.9	78.8	7.8	9.9	81.9	7.9	9.6	85.5	8.0	9.4	80.9	6.2	7.7
Efficiency CIUpm	1	98.2	29.2	29.7	89.0	27.0	30.3	120.0	31.5	26.3	124.7	36.9	29.6	107.9	25.0	23.2
	2	109.3	32.4	29.6	99.1	30.8	31.1	123.7	31.2	25.2	126.3	35.5	28.1	114.6	24.7	21.6
	3	103.7	31.3	30.2	92.5	28.7	31.0	116.4	27.1	23.3	120.7	27.8	23.0	108.3	21.4	19.8
	4	109.7	21.3	19.4	101.7	23.7	23.3	129.8	27.3	21.0	128.4	32.7	25.5	117.4	19.8	16.9
	All	105.8	29.2	27.6	96.0	28.1	29.3	122.6	29.5	24.1	125.0	33.2	26.6	112.4	23.0	20.5

Note: CoV interpreted as <10% low, >20% high, and >30% very high variability Pimentel-Gomes, 1985. Age: 1 = 12 year-olds; 2 = 13 year-olds; 3 = 14 year-olds; 4 = 15 year-olds; %CIU = percent CIU of total words; CIUpm = number of CIUs per minute of discourse

Table 4.4
Descriptive statistics (sum, mean, and standard deviation) for super-structural variables across age groups and genres.

Measure	12-12;11			13-13;11			14-14;11			15;15;11		
	#	*M*	*SD*	#	*M*	*SD*	#	*M*	*SD*	#	*M*	*SD*
Recount												
Orientation - Character	33	2.7	0.9	49	2.5	0.7	39	2.7	0.5	37.0	2.5	0.9
Orientation - Location	32	1.5	0.8	43	1.2	0.7	37	1.4	0.7	36.0	1.5	0.7
Orientation - Time	24	1.3	0.9	38	**1.2**[a]	0.9	32	**1.3**[b]	0.9	35.0	**1.8**[ab]	1.0
Orientation - Other	24	0.9	0.7	35	1.0	0.8	22	0.8	0.5	29.0	1.2	1.0
Initiating event	5	0.2	0.4	12	0.2	0.4	9	0.2	0.4	6.0	1.6	0.4
Event	33	16.7	11.6	49	18.8	15.1	39	14.1	12.0	38.0	18.2	11.7
Elaborations of detail	29	5.9	8.6	46	8.6	9.2	34	5.8	8.8	33.0	6.9	6.3
Evaluations	20	2.2	3.3	40	3.3	3.7	26	2.6	4.0	28.0	3.1	3.0
Conclusion	6	0.2	0.4	13	0.3	0.6	5	0.2	0.4	11.0	0.3	0.5
End marker	13	0.8	1.1	28	0.8	0.9	25	1.0	1.0	22.0	0.7	0.7
Restatement of question	1	0.0	0.2	5	0.1	0.3	2	0.1	0.2	4.0	0.1	0.3
Genre shift	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0
Schema deviation	28	2.7	1.8	48	3.0	3.1	34	1.9	1.5	34.0	2.7	2.2
Order deviation	2	0.1	0.2	7	0.1	0.4	2	0.1	0.2	3.0	0.1	0.4
Exposition												
Thesis statements	28	1.8	1.1	47	2.1	0.9	35	2.0	1.0	34.0	1.9	1.0
Sub-category	33	5.1	3.5	47	5.7	3.9	36	**5.3**[a]	4.7	38.0	**7.1**[a]	4.3
Elaborations of detail	26	2.6	2.7	39	3.0	3.4	27	2.5	2.9	33.0	3.2	3.3
Evaluation	11	0.5	0.8	25	1.1	1.4	12	0.6	1.6	20.0	0.9	1.2
Conclusion	2	0.1	0.2	3	0.1	0.2	1	0.0	0.2	2.0	0.1	0.2
End marker	21	1.1	1.1	32	1.1	1.0	26	1.2	1.1	18.0	0.8	1.0
Restatement of question	1	0.0	0.2	5	0.1	0.3	2	0.1	0.2	2.0	0.1	0.2
Genre shift	7	0.4	1.0	10	0.3	0.7	3	0.1	0.3	5.0	0.2	0.6
Schema deviation	32	3.6	1.8	46	3.4	1.9	35	3.0	2.0	38.0	3.6	1.3
Order deviation	7	0.2	0.4	13	0.3	0.6	4	0.1	0.3	9.0	0.3	0.5
Persuasion												
Thesis / opinion	33	2.5	0.6	49	2.5	0.8	38	2.4	0.8	36.0	2.5	0.8
Supporting argument	33	5.1	2.3	49	**6.5**[a]	2.7	39	**5.3**[a]	2.3	37.0	6.1	2.6

Table 4.4

Descriptive statistics (sum, mean, and standard deviation) for super-structural variables across age groups and genres.

	12-12;11			13-13;11			14-14;11			15;15;11		
Measure	#	*M*	*SD*	#	*M*	*SD*	#	*M*	*SD*	#	*M*	*SD*
Counter argument	22	1.1	1.2	27	0.9	1.2	24	1.2	1.5	24.0	1.1	1.1
Elaboration	32	3.9	2.4	49	4.5	2.8	36	3.5	3.0	37	4.0	2.9
Evaluation	13	0.6	0.8	17	0.6	1.0	9	0.5	1.1	16	0.8	1.2
Conclusion	13	**.5**[a]	0.7	28	**.8**[b]	0.8	16	0.6	0.9	27	**1.1**[ab]	0.9
End	12	0.5	0.7	22	0.6	0.8	20	0.8	0.9	8	0.3	0.6
Restatement of question	0	0.0	0.0	1	0.0	0.1	0	0.0	0.0	0	0.0	0.0
Genre shift	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	1	0.1	0.3
Schema deviation	28	2.3	1.5	43	2.2	1.9	27	1.5	1.4	32	2.1	1.7
Order deviation	4	0.2	0.4	8	0.2	0.6	3	0.1	0.3	4	0.2	0.6
Narrative												
Orientation - Character	33	2.4	0.7	49	2.3	0.8	37	2.1	0.7	37	2.0	0.6
Orientation - Location	14	0.5	0.6	24	0.5	0.6	17	0.5	0.6	22	0.7	0.7
Orientation - Time	10	0.5	0.8	15	0.3	0.5	9	0.3	0.5	17	0.5	0.7
Orientation - Other	9	0.4	0.7	10	0.3	0.6	9	0.3	0.5	11	0.3	0.5
Initiating event	33	1.9	0.7	46	1.8	0.9	34	1.6	0.8	35	1.8	0.8
Response	10	0.3	0.5	16	0.4	0.6	8	0.2	0.6	14	0.5	0.7
Events	33	17.9	12.1	49	17.2	14.6	37	13.9	10.6	36	19.3	17.9
Reflective comments	12	0.9	1.4	16	0.5	0.9	12	0.4	0.8	17	1.2	1.9
Elaborations	13	0.7	1.1	27	1.0	1.2	13	0.6	0.9	18	1.3	2.0
Conclusion	28	0.8	0.8	29	0.7	0.7	13	0.4	0.6	29	1.0	0.7
End marker	17	0.7	0.7	23	0.7	0.9	20	0.7	0.8	20	0.7	0.7
Restatement of question	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0
Genre shift	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0
Schema deviation	19	1.1	1.4	29	1.5	3.7	23	1.0	1.0	22	0.8	0.8
Order deviation	1	0.0	0.2	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0

Note: Values with the same superscript values are significantly different at corrected alpha ($p < .0125$).

Table 4.5

Descriptive statistics (mean, standard deviation) for CUDP-A variables across gender groups

		Recount		Exposition		Persuasive		Narrative		All	
Feature / variable	Group	M	SD	M	SD	M	SD	M	SD	M	SD
Productivity											
Total c-units	Male	40.2	42.5	19.4	13.9	26.9	24.5	32.9	33.1	119.3	92.4
	Female	41.3	39.0	23.9	21.2	28.9	19.8	35.4	27.7	129.6	88.1
Lexical diversity											
NDW	Male	124.7	85.4	81.9	47.7	109.0	64.7	132.8	81.4	448.3	243.0
	Female	125.4	76.9	96.3	57.1	118.8	51.4	136.3	62.7	476.7	203.7
Fluency											
Total Mazes	Male	21.0	24.9	13.1	9.6	18.0	22.1	14.1	22.5	66.3	65.6
	Female	21.3	27.8	20.6	21.4	21.6	18.8	15.3	18.4	78.7	71.0
%Maze words	Male	9.9	5.1	13.4	6.8	10.9	5.2	6.7	5.8	10.2	4.5
	Female	8.8	4.2	13.6	6.9	10.3	5.3	6.2	4.0	9.7	4.2
Morpho-syntactic complexity											
MLUw	Male	7.8	1.4	8.2	1.9	10.1	2.2	10.5	2.4	9.2	1.2
	Female	7.8	1.2	8.9	1.8	11.2	2.5	10.3	2.1	9.6	1.3
Clausal density	Male	1.1	0.2	1.3	0.3	1.6	0.4	1.3	0.2	1.3	0.1
	Female	1.1	0.2	1.3	0.2	1.7	0.5	1.4	0.3	1.4	0.2
Cohesive frequency											
Total referential ties	Male	24.1	28.2	11.8	11.2	18.7	16.0	29.0	27.5	83.6	65.5
	Female	26.2	29.6	15.9	15.6	20.9	17.2	32.9	24.1	95.9	71.2
Cohesive adequacy											
%Correct ties of total	Male	62.7	25.8	58.6	35.4	56.2	28.4	87.8	21.0	66.3	18.1
	Female	62.8	23.9	67.0	31.9	54.3	27.2	93.6	11.7	69.4	15.6
Coherence											
Local coherence	Male	3.9	0.4	3.4	1.0	3.8	0.5	4.2	0.5	3.8	0.4
	Female	3.9	0.5	3.8	0.6	3.9	0.4	4.3	0.5	4.0	0.3
Global coherence	Male	4.3	0.4	4.0	0.6	4.3	0.5	4.7	0.3	4.3	0.3
	Female	4.3	0.4	4.3	0.5	4.4	0.4	4.8	0.2	4.5	0.3
Relevance	Male	78.8	6.7	76.4	10.8	80.7	8.9	84.0	9.6	79.9	6.6

Feature / variable	Group	Recount M	Recount SD	Exposition M	Exposition SD	Persuasive M	Persuasive SD	Narrative M	Narrative SD	All M	All SD
%CIU											
	Female	78.8	8.6	78.6	9.0	82.9	6.9	86.7	6.2	81.8	5.7
Efficiency											
CIUpm	Male	102.8	28.8	94.6	30.1	119.5	31.7	120.5	30.4	109.3	23.7
	Female	108.2	29.6	97.1	26.4	125.1	27.6	128.7	35.1	114.8	22.3
Text organisation											
Schema deviations	Male	2.8	2.1	3.8	1.6	2.2	1.9	1.2	3.2	9.0	6.4
	Female	2.5	2.5	2.9	1.9	1.9	1.5	1.0	1.1	9.3	4.2
Order deviations	Male	0.1	0.4	0.2	0.5	0.1	0.4	0.01	0.1	0.5	0.8
	Female	0.1	0.3	0.2	0.5	0.2	0.5	n/a	n/a	0.5	0.8
Genre shifts	Male	n/a	n/a	0.2	0.5	0.03	0.2	n/a	n/a	0.2	0.6
	Female	n/a	n/a	0.3	0.8	n/a	n/a	n/a	n/a	0.3	0.8
Restatement of question	Male	0.1	0.3	0.1	0.3	0.01	0.1	n/a	n/a	0.2	0.5
	Female	0.1	0.2	0.03	0.2	n/a	n/a	n/a	n/a	0.1	0.3

Note: 'n/a' = code did not appear in sample

Table 4.6

Descriptive statistics for genre-specific super-structural variables across age groups and genres (total, mean, and standard deviation)

	Male (n=72)		Female (n=88)	
Genre / variable	*M*	*SD*	*M*	*SD*
Recount				
Orientation - Character	2.5	0.7	2.6	0.8
Orientation - Location	1.4	0.8	1.4	0.7
Orientation - Time	1.1	0.9	1.6	0.9
Orientation - Other	0.9	0.8	1.0	0.9
Initiating event	0.2	0.4	0.2	0.4
Event	17.2	15.0	17.0	11.1
Elaborations of detail	6.5	8.4	7.3	8.3
Evaluations	2.5	3.7	3.1	3.4
Conclusion	0.3	0.5	0.2	0.5
End marker	0.9	0.9	0.8	0.9
Schema deviation	2.8	2.1	2.5	2.5
Order deviation	0.1	0.4	0.1	0.3
Genre shift	n/a	n/a	n/a	n/a
Restatement of question	0.1	0.3	0.1	0.2
Exposition				
Thesis statements	1.9	1.0	2.0	1.0
Sub-category	4.6	3.2	6.9	4.5
Elaborations of detail	2.6	3.1	3.0	3.1
Evaluation	0.7	1.0	1.0	1.5
Conclusion	0.02	0.2	0.1	0.3
End marker	1.5	1.1	0.7	0.9
Schema deviation	2.9	1.9	3.8	1.6
Order deviation	0.2	0.5	0.2	0.5
Genre shift	0.2	0.5	0.3	0.8
Restatement of question	0.1	0.3	0.03	0.2
Persuasion				
Thesis / opinion	2.3	0.9	2.6	0.6
Supporting argument	5.3	2.8	6.1	2.3
Counter argument	0.8	1.0	1.3	1.4
Elaboration	3.5	2.4	4.5	3.0
Evaluation	0.4	0.8	0.8	1.2
Conclusion	0.6	0.8	0.9	0.9
End marker	0.7	0.8	0.4	0.7
Schema deviation	2.2	1.9	1.9	1.5
Order deviation	0.1	0.4	0.2	0.5
Genre shift	0.03	0.2	n/a	n/a
Restatement of question	0.01	0.1	n/a	n/a
Narrative				
Orientation - Character	2.2	0.9	2.2	0.6
Orientation - Location	0.5	0.6	0.6	0.7
Orientation - Time	0.4	0.6	0.4	0.6
Orientation - Other	0.3	0.5	0.3	0.6
Initiating event	1.7	0.9	1.8	0.7
Response	0.4	0.6	0.4	0.6

Table 4.6

Descriptive statistics for genre-specific super-structural variables across age groups and genres (total, mean, and standard deviation)

	Male (n=72)		Female (n=88)	
Genre / variable	*M*	*SD*	*M*	*SD*
Events	16.0	15.1	17.9	13.3
Reflective comments	0.7	1.2	0.8	1.4
Elaborations	0.7	1.3	1.0	1.4
Conclusion	0.5	0.7	0.9	0.8
End marker	1.0	0.8	0.5	0.6
Schema deviation	1.2	3.2	1.0	1.1
Order deviation	0.01	0.1	n/a	n/a
Genre shift	n/a	n/a	n/a	n/a
Restatement of question	n/a	n/a	n/a	n/a

Note: 'n/a' = code did not occur in samples

Correlations between Discourse Measures

Significant correlations occurred between multiple discourse measures; ranging from 0.17 to 0.94 across genre and levels of analysis. See Appendix G.1 for correlation matrix.

Correlations Between Oral Language and Discourse

Significant correlations were observed between CELF-4 CLS (*M*= 117.7; *SD* = 10.4) and discourse measures. Coefficients ranged from 0.17 to 0.35 across genre, with most significant correlations observed at the micro-linguistic level. See Appendix G.2 for correlation matrix.

Discussion

This study reports on the development of a novel assessment tool, the CUDP-A, used to collect and describe samples of everyday spoken discourse from 160 adolescents, between 12 and 15 years of age, to address the gap in assessment tools and normative data for this age group. Discourse samples were assessed using measures sensitive to micro-linguistic to super-structural features drawn from Coelho's (2007) measurement framework. Consistent with past research in clinical and non-clinical populations, variability was observed across the measures, with discourse samples particularly variable in terms of micro-linguistic features of productivity, fluency, and syntactic complexity across participants (Nippold et al., 2008; Scott & Windsor, 2000; Westerveld & Vidler, 2016). Micro-structural features were variable in terms of cohesive frequency (i.e. total number of referential ties), a factor, that likely reflects variability in sample length and the need for a greater or lesser number of cohesive ties. This is consistent with previous studies in clinical populations where longer samples provided greater opportunity for speakers to demonstrate a range of oral language features (Ewing-Cobbs, 1998; Van Leer, 1999). In contrast, the adequacy of cohesive ties produced was relatively stable across participants. This indicated that participants in the sample demonstrated similar levels of ability in selecting the most accurate cohesive tie, regardless of sample length. This finding is also consistent with past literature, and may reflect cognitive-linguistic development in this age group, particularly knowledge of appropriate pronouns and theory of mind, which is largely consolidated at this age (Van Leer, 1999; Zelazo, 2012).

Measures of discourse macro-structure were notably stable in this sample. In particular, participants were similar in terms of coherence (local and global) and relevance (%CIU). In contrast, participants varied considerably in the efficiency (CIUpm) of information transfer across genres. While there has been limited exploration of relevance and efficiency using CIU analysis (Nicholas & Brookshire, 1993) outside of the adult literature, the results were consistent with previous observations of relative stability in coherence and relevance and instability in efficiency in adolescents and young adults (Capilouto, 2005; Matsuoka, 2012). The inconsistency in efficiency may reflect variability in the time adolescents require to process and plan clear and informative descriptions of their thoughts and ideas (Matsuoka et al., 2012).

Finally, at the super-structural level, participants' samples contained comparable numbers of core schema components across genres. This supports the notion that individuals are generally competent in structuring both narrative-based (personal recount and fictional narrative) and fact-based (expository and persuasive discourse) discourse by the secondary-school years (Nippold et al., 2005). Conversely, participants varied in their inclusion of ending and concluding statements across genres, which is congruent with the findings of Whitworth et al (2015) who observed wide variability in CUDP super-structure measures in adult speakers, including the tendency to exclude conclusive statements. The requirement to include clear ending or concluding statements may be an artefact of more formal literate discourse, and the informal nature of oral discourse may limit the requirement for these components. This is an important consideration given the super-structural variables of both the CUDP and the CUDP-A were informed by literature on written discourse (Ministry of Education Western Australia, 2013). Future studies of discourse super-structure may not explicitly assess production of ending or concluding statements given the tendency for many participants to omit these components entirely.

Age and Gender Differences

Consistent with previous research, features at the micro-linguistic, micro-structural, and macro-structural levels were largely stable across age and gender groups (Mäkinen, 2014; Reese, 2011). In terms of age, some differences were observed in the provision of core schema elements across each genre. The relative paucity of age-related differences in super-structure for personal recount and fictional narrative samples indicates the structure of narrative-based discourse may be largely consolidated by late childhood (O'Kearney, 2007). In contrast, a higher number of age-related differences were observed within more complex expository and persuasive text construction, though older participants did not necessarily perform better than their younger peers. This is congruent with previous reports of heterogeneous acquisition of the structure of complex expository and persuasive discourse tasks as adolescents encounter these genres more frequently in social and academic contexts (Nippold et al., 2005). In line with previous literature, few differences between male and female participants were observed across CUDP-A variables (Channell et al., 2018; Nippold et al., 2017). The findings regarding global coherence and expository structure warrant further investigation of effects of gender on features above the word and sentence level, given the implications for identification of discourse-level deficits in clinical populations across genders (Lundine et al., 2018).

Drawing on Theory of Discourse Processing

Discourse production requires the integration and processing of multiple, interconnected levels of language skills (Frederiksen & Stemmer, 1993). When examining language skills, Jakobson (1980) recommended that both "the totality and the interrelation between the different parts of the totality have to be taken into account" (p. 95) to obtain a comprehensive profile. In response, a series of correlational analyses were undertaken among discourse variables (see Appendix G.1) and between the measures used and CELF-4 CLS (see Appendix G.2). Results were generally consistent with Frederiksen and Stemmer's (1993) model of discourse processing, and support the application of this model in adolescent discourse.

Participants with better underlying oral language skills produced longer, more fluent, and lexically diverse discourse, as well as that which was more cohesively adequate and well-organized. These results are consistent with previous observations in children with and without language deficits including ASD (Bishop, 2005; Norbury & Bishop, 2003; Scott, Tetnowski, & Yaruss, 2014). It was not surprising to observe the greater number of correlations between the CELF-4 and discourse features at micro-linguistic and micro-structural levels given the CLS reflects word and sentence-level language skills (Semel et al., 2003). Of interest was the finding of associations between CELF-4 CLS and CUDP-A variables in the context of recount and expository discourse only. Participants with poorer oral language skills may have experienced greater difficulty in marking macro- and super-structural features when constructing these genres relative to persuasive or fictional narrative texts. Similar conclusions have been drawn in young school-age children and children with DLD, which suggests potentially disproportionate language demands across contexts (Colozzo, Gillam, Wood, Schnell, & Johnston, 2011; Westerveld & Moran, 2011). This is an important avenue for future investigation as inter-genre variation in discourse skills is likely to have has implications for assessment in this age group.

A range of significant relationships within and across micro-linguistic to super-structural CUDP-A variables were observed. In this sample, better adherence to discourse schema (e.g. story grammar) was related to more cohesive, coherent, informative, and relevant content, as well as more complex syntax and greater fluency in discourse. In contrast, samples that were not appropriately organised were related to poorer topic management, increased length, and reduced informativeness. Not surprisingly, longer samples were positively associated with frequency counts of other language measures, such as lexical diversity and use of cohesive ties, as discussed previously. The results did, however, show that discourse length was not associated with the complexity or quality of output, which suggests a complex relationship between structure and content (Berman & Nir-Sagiv, 2007).

The relationships observed between discourse and oral language variables are generally in accordance with the processes illustrated in Frederiksen and Stemmer's model (1993). Here, planning begins with the activation of a contextually appropriate discourse framework (such as narrative Story Grammar; Stein & Glenn, 1979), which facilitates the retrieval, sequencing, and encoding of informative and appropriate content. Competent progression through these stages is reliant on higher-level cognitive-linguistic processes as well as underlying oral language skills (Frederiksen & Stemmer, 1993). The latter stages of this model describe progression from the retrieval and organisation of discourse frameworks and content to appropriate lexical and morpho-syntactic encoding, which involves skills indexed by the CELF-4 CLS (Semel et al., 2003). These findings support the conceptualisation of adolescent discourse planning as a dynamic, complex, process that draws on micro-linguistic to super-structural language skills. An enhanced understanding of the relationship between behaviours measured in discourse analysis has implications for our understanding of characteristics of discourse deficits in clinical populations, and selection of appropriate therapy targets. Furthermore, these results support the use of Frederiksen and Stemmer's (1993) model in interpreting the nature of everyday adolescent discourse and in assessment and intervention planning.

Implications of this Study

The CUDP-A has enabled collection of a relatively large sample of adolescent discourse, across four genres relevant to the social and academic contexts, that has both clinical and theoretical implications. Clinically, the results of this study provide preliminary support for the use of the CUDP-A to characterize spoken discourse in adolescents across genres, and to identify potential targets for intervention across micro-linguistic to super-structural features. This study documented considerable variability in micro-linguistic and micro-structural compared to macro-structural and super-structural features. As such, measures sensitive to macro- and super-structural features, such as local and global coherence, CIU analysis, and tallies of genre deviation, may be more sensitive to difficulties in discourse relative to what is expected of the adolescent reference sample, suggesting that these may be more suitable to use within clinical practice to efficiently detect difference. Few age or gender-related differences were observed across CUDP-A variables, although observations of some significant results warrant further investigation of demographic factors influencing adolescent discourse. Discourse samples were, however, largely comparable for males and females in the early to mid-adolescent years. Correlations between performance on the CUDP-A and on a gold-standard oral language assessment provide preliminary evidence for the validity of this protocol and may enhance our ability to identify and describe the oral language skills that contribute to the overall extent and nature of discourse deficits in clinical populations. From a theoretical perspective, these findings enhance our understanding of the language processes related to discourse skills and support the application of Frederiksen and Stemmer's (1993) model to adolescent discourse.

Limitations and Future Directions

This study is not without limitations. All participants spoke English as their first language, received a mainstream education, and were recruited from a metropolitan area. The application of the results may be limited in adolescents who fit these criteria until further research is carried out on a more heterogeneous population. Results also revealed limited development in discourse between early to mid-adolescence. Future studies would benefit from recruiting a larger sample across a wider age range to detect stability and subtle nuances in discourse development to determine possible factors influencing performance (Mäkinen et al., 2014; Westerveld & Vidler, 2016). This has important implications for the development of reference discourse data that acknowledges the apparent variability in discourse output in this age group. As with many studies when sampling spoken production, a potential confound was that participants' prior knowledge of topics covered by the CUDP-A was not determined. Each topic was selected because of its presence in the Australian curriculum, but participants' prior understanding may have influenced their ability to respond to the task stimuli. Closer examination of the influence of topic and genre on discourse performance would have implications for the optimal identification and management of discourse impairments. In particular, future research should focus on the development and characteristics of conversational discourse skills across adolescence, given the importance of conversation in daily academic and social participation at this age (Turkstra, 2000). Further examination of the significant associations between oral language skills and spoken discourse may improve the understanding of the linguistic demands of discourse, and the role of underlying language skills in daily communication. Application of the CUDP-A in clinical populations such as DLD, acquired brain injury or Autism Spectrum Disorder should also remain a focus of research.

Conclusions

This study has provided an in-depth analysis of the everyday monologic discourse of 160 adolescents using a novel protocol, the CUDP-A, an age-appropriate method to assess adolescent discourse. Variable discourse profiles were observed in the presence of few age- and genre-related effects and significant associations with underlying oral language skills. It is anticipated that this new tool will facilitate further examination of adolescent discourse skills for clinical and research purposes.

Chapter 5

Genre-related Differences in Discourse Skills in Adolescents without ABI

Chapter Overview

With an improvement in medical management and access to rehabilitative services, adolescents with ABI are more likely to reintegrate into mainstream classrooms (Coreno & Ciccia, 2020). As such, the CUDP-A was developed to assess a range of skills in event- and topic-centred discourse required by daily social and academic interaction (Lundine & Hall, 2020). Time taken to elicit and analyse discourse samples across a range of genres remains a current barrier to clinical practice (Study 2). As clinicians more frequently administer narrative-based tasks when assessing discourse skills, it crucial that we establish that performance in narrative assessment reflects competence across other event- and topic-centred genres. Past studies in younger children have documented significant differences between narrative discourse and conversational (Nippold et al., 2014) and expository discourse (Scott & Windsor, 2000; Westerveld & Vidler, 2016). Similarly, researchers have observed differences in language profiles between narrative and expository summaries in adolescents without language impairment (Lundine et al., 2018). Task-related factors, including genre, are also a critical component of the contextual domain that influence communication competence according to MacDonald's (2017) model. Few studies have, however, examined variability in adolescent discourse skills across event- versus topic-centred tasks.

The current chapter presents the second study of Part Two of this research program (Study 4). This study draws on the reference data collected in Study 3 to explore potential variability in discourse performance across event- versus topic-centred monologic genres. To enable the application of findings to clinical practice, generally, the results and implications are broadly contextualised within clinical and non-clinical populations. This chapter presents an original manuscript that has been submitted for publication and is currently under review. The manuscript has been formatted to align with the larger thesis document. As with previous chapters, there is some repetition of the literature and methodology described in previous chapters, yet every attempt has been made to avoid this.

Abstract

Purpose: While narrative discourse has been the focus of traditional, standardised language assessment with the paediatric population, awareness of the complex discourse needs of adolescents has increased interest in profiling discourse within other monologic genres. This interest is not commensurate, however, with a robust understanding of the influence of genre in adolescence, spanning word to whole-text level language features. This knowledge is important to inform the selection of appropriate context(s) for assessment to profile a range of strengths and weaknesses in oral discourse.

Method: 160 adolescents between 12-15 years (M = 13;1, SD=1;1, 55% female, 45% male) were administered the Curtin University Discourse Protocol – Adolescent version. For each participant, samples of recount, narrative, expository, and persuasive discourse were coded using a multi-level analysis procedure.

Result: Genre had a significant influence on language variables regardless of age. Narrative tasks elicited the longest, most lexically diverse, cohesive, coherent and well-structured output. Results were largely consistent with the oral to literate continuum and order in which genres are introduced in the academic curriculum.

Conclusion: Structure, content, and domain-specific knowledge were likely to play a role in the genre-related differences observed in this cohort of adolescents. The results indicate it would be advantageous to sample skills across a range of monologic genres when assessing adolescent discourse and declarative knowledge may be an important consideration in topic selection.

Keywords: Discourse, narrative, expository, language, assessment, adolescent

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Introduction

Adolescents are required to communicate effectively across many social and academic contexts. The use of discourse-level language is particularly vital for successful participation in the classroom, to form and maintain friendships, and for emotional development (Turkstra, 2000). Discourse skills refer to an individual's use of language to communicate for a particular purpose whilst integrating the contextual and pragmatic demands of different contexts (Sullivan & Riccio, 2010). Academically, adolescents are expected to construct a range of texts such as procedural, expository, or persuasive discourse within scientific discussions, debates, and other classroom interactions (School Curriculum and Standards Authority [SCSA], 2016). Socially, adolescents require competent skills in monologic tasks to form and maintain meaningful relationships (Turkstra, 2000). Discourse-level language skills across a range of genre are therefore a critical consideration for speech pathologists (Dipper & Pritchard, 2007).

Discourse Genres in Adolescence

Four everyday monologic genres that are frequently required by the social and academic contexts of adolescence are recount, narrative, expository, and persuasive discourse (Nippold, 2007). Recounts involve the description of one or a series of events, often personally-experienced, to a listener and are essential for social communication and building social relationships (Turkstra, 2000). Narrative also refer to the description of a series of events, although these events are typically fictional. Recount and narrative discourse are both generally organised according to chronological, temporal, logical and/or causal relationships using a typical organisational structure, or story grammar (Stein & Glenn, 1979).While not frequently encountered in the later school years, academic content can also be presented in a narrative format, and students are expected to demonstrate skills in the construction of cohesive fictional narratives in their academic work (Australian Curriculum Assessment and Reporting Authority ([ACARA], 2015). Socially, older children and adolescents are expected to adequately recount past events and personal experiences in social settings, with the ability to produce well-formed narratives remaining central to psychosocial and emotional development (Reed & Spicer, 2003). As students enter secondary school, greater emphasis is placed on production of expository and persuasive discourse (Turkstra, 2000). Expository discourse refers to the use of language to convey information (Nippold, 2007). Adolescents are regularly exposed to expository discourse in the academic context across a range of subjects, contributing to its reputation as the "language of the curriculum" (Ward-Lonergan & Duthie, 2013, p. 44), and the ability to construct coherent expositions is integral to academic success (Ward-Lonergan & Duthie, 2013). Persuasive discourse refers to "the use of argumentation to convince another person to perform an act or accept the point of view desired by the persuader" (Nippold, 2007, p.305). Persuasive discourse is considered to be the most complex discourse form as it requires abstract reasoning, logical thinking and demands on theory of mind (Heilman, Malone, & Westerveld, 2020). In Australia, students are expected to create "persuasive texts that raise issues, report events, and advance opinions, using deliberate language and textual choices" (ACARA, 2015, p. 22) by year 8, and to "hone their oral communication skills through discussion, debate and argument, in a range of formal and informal situations" (SCSA, 2017, p. 1) by year 12. Expository and persuasive genres also play a notable role socially in navigating interpersonal relationships (Turkstra, 2000).

The Influence of Genre on Adolescent Discourse

Previous investigations in younger children have observed considerable differences in word and sentence-level language features between different monologic genres. Scott and Windsor (2000) examined differences between discourse samples elicited as summaries of narrative and expository texts in children aged 7 and 12. Summaries were measured on indices of productivity, fluency, lexical diversity, and grammatical complexity. Their results indicated expository summaries were shorter, less fluent, and more complex and error prone than narratives. Westerveld and Vidler (2016) examined differences in discourse skills across conversation, recount, and expository contexts in 127 children aged 5 to 8 years. Their results also revealed longer and more morphologically complex samples in expository compared to recount samples.

The influence of genre on adolescent language skills remains a relatively under-researched area. Brimo and Hall-Mills (2019) compared syntactic complexity and clausal density in persuasive and expository samples in 64 adolescents without language impairment. The production of more complex syntax in persuasive tasks compared to expositions was observed, and attributed to the requirement of complex sentences to convey reasoning and abstract thought (Brimo & Hall-Mills, 2019). Lundine et al. (2018) extended the work of Scott and Windsor (2000) and examined differences in features of summaries of narrative versus expository texts produced by 50 adolescents between the ages of 13 to 18 years. Samples were assessed on measures of productivity and morphosyntactic complexity as well as 'summary quality', which was sensitive to the structure, amount, accuracy, and relevance of content, use of conjunctions, and sentence structure. Their results indicated that summaries of expositions were shorter, less complex, and of poorer quality than the narratives samples. Beyond these studies, however, we have restricted knowledge of variability in adolescents' discourse-level language profiles between types of monologic discourse (Lundine, Harnish, McCauley, Blackett, Zezinka, Chan, & Fox, 2018).

The majority of past studies into genre-related differences in child and adolescent discourse skills have examined traditional word to sentence-level features (Scott & Windsor, 2000). Nippold (1998) argues that any analysis of adolescent discourse should adopt measures sensitive to "sophisticated linguistic phenomena" (p. 3), as language becomes more complex throughout adolescence into adulthood (e.g. Channell, McDuffie, Bullard, & Abbeduto, 2015). There is currently debate, however, about which measures are most suitable measures to analyse discourse output (Spencer, Bryant, & Colyvas, 2020). Adult discourse literature includes an array of measures that assess word to whole-text level language features. Coelho (2007) describes four categories of measurement: micro-linguistic, micro-structural, macro-structural, and super-structural, that originate in the cognitive-communication literature and delineate a series of word to whole-text measures. Micro-linguistic measures refer to the traditional word and sentence-level indices that have been used in studies of paediatric discourse such as total words, MLU, lexical diversity and syntactic complexity (Coelho, 2007). Micro-structural indices capture the use of cohesive ties to link characters or concepts between and within sentences. Macro-structural measures are sensitive to the coherence and thematic unity of discourse, and super-structural measures (often referred to as macro-structure in discourse literature), refer to whole-text level structural organisation of discourse (Coelho, 2007). As adolescent discourse represents a shift to more complex discourse content and structures, a multi-level approach to analysis would be a useful way to examine variability in adolescent discourse that exists between genres.

Genre-related Differences and Processing Requirements

Differences in the content, structure, and processing requirements of various genres have been linked to variability in language profiles across tasks. Current theoretical models illustrate a close link between content, structure, and declarative knowledge in discourse processing. For instance, in both Frederiksen and Stemmer's (1993) and Levelt's (1989) models of discourse processing, utterance and word-level syntactic, morphological, and phonological encoding is facilitated by the activation and retrieval of the appropriate schematic framework and general world knowledge. This interaction has previously been used to interpret genre-related differences in adolescents discourse in the written modality. Berman and Nir-Sagiv (2007) attributed differences between narrative and expository writing to variability in the processing requirements of event-based versus topic-based genres. Tasks that require an account of a series of events, such as recount and narrative discourse, are proposed to draw on mechanisms of bottom-up processing (Berman & Nir-Sagiv, 2007). Here, the retrieval and sequencing of language content draws on, and is facilitated by, familiarity with the structural requirements of event-based story grammar. In contrast, tasks that involve fact-based and more abstract content, such as persuasive or expository discourse, rely more heavily on top-down processing mechanisms. Here, the content of discourse is largely guided by the extent of general knowledge of the discourse topic and exposure to fact-based texts (Berman & Nir-Sagiv, 2007). For this reason, persuasive and expository texts are considered, empirically, more cognitively and linguistically challenging, and therefore later developing, forms of discourse (Nippold, 2007). The link between general knowledge, structure, and linguistic content is consistent with the notion that "complex thought drives the development of complex language" (Nippold, Hesketh, Duthie, & Mansfield, 2005, p. 1058), and supports the use of a range of word to whole-text-level language measures in discourse analysis, particularly in an adolescent population.

Genres in Discourse Assessment

Clinicians report the more frequent assessment of narrative skills than any other genre when assessing discourse in paediatric populations (Westerveld & Claessen, 2014) using self-generated protocols or standardised batteries. While narratives provide valuable insight into discourse skills, and have been described as the "canary in the coalmine" (Snow & Powell, 2008, p.17) of language in childhood in providing early signs of discourse difficulties, evidence suggests they may not adequately capture the complexities of adolescent language (Lundine et al., 2018). Some tools developed for clinicians working with adolescents to address this issue including the protocols for expository (Heilman & Malone, 2014; Nippold et al., 2005) and persuasive discourse (Heilman et al., 2020), with normative data for adolescents aged 10 to 18 years available through the Systematic Analysis of Language Transcripts (SALT; Miller & Iglesias, 2019). Clinicians also have access to the Curtin University Discourse Protocol – Adolescent version (CUDP-A; Hill et al., 2020), which provides an elicitation and scoring protocol for recount, narrative, expository, and persuasive discourse skills and adolescent reference data on micro-linguistic to super-structural variables. Despite the availability of these tools, we have a limited understanding of whether specific genres are more informative than others in characterising adolescent discourse or whether similar patterns are seen across different genres.

The Current Study

The current study examines genre-related variability in adolescent discourse skills across four monologic genres using a multi-level analysis procedure (Coelho, 2007).This study draws on the CUDP-A reference data published in Hill et al. (2020) to examine differences in micro-linguistic through to super-structural language features of recount, narrative, persuasive and expository samples in adolescents between 12 to 15 years of age.

Method[12]

Participants

Participants included the 160 adolescents (male = 72; female = 88) recruited as the reference sample of the CUDP-A (Hill et al., 2020). Participants were aged between 12;0 to 15;11 years of age (M= 13;1, SD= 1;1). The primary inclusion criteria were attendance at mainstream school and English as their first and primary language. These criteria were developed for the original study to ensure, in the initial reference group, relatively homogeneous exposure to English. While bilingual children were included in the study, other languages spoken in addition to English

[12] See Appendix A for additional methodological detail

were limited to Azari, Japanese, Spanish, and Farsi (each n=1). No participants spoke non-standard dialects of English. Exclusion criteria for the study included a diagnosed intellectual disability, neurological disorder, and/or Autism Spectrum Disorder. A history of speech pathology intervention was not an exclusion criterion providing the other criteria were met. Twenty-eight participants reported a history of speech pathology intervention. Reasons for intervention included articulation (n=18), phonological awareness (n=2), stuttering (n=6), and literacy (n=2). The Clinical Evaluation of Language Fundamentals – Fourth Edition (CELF-4; Semel et al., 2003) was administered to obtain a Core Language Score and identify presence of language disorder or delay. All participants obtained a Core Language Score (CLS) greater than 80 (M=117.7, SD = 10.4, *range* = 85 to 140) indicating no presence of language disorder or delay (Semel et al., 2003). Participants were seen individually for one 60-minute session during which the CELF-4 and the CUDP-A were administered.

Measures

General oral language skills

Expressive and receptive language skills were measured using the CELF-4 (Semel et al., 2003), which is a widely-used standardised assessment of oral language that is normed on an American standardisation sample of 2650 individuals between 5 to 21 years of age (Semel et al., 2003). The CLS represented performance across the five following subtests; Concepts and Following Directions, Recalling Sentences, Formulated Sentences, Word Classes, and Word Definitions (Semel et al., 2003)

Oral discourse skills

Using the CUDP-A (Hill et al., 2020), each participant produced 11 discourse samples across four genres: recount (n= 3), narrative (n=2), expository (n= 3), and persuasive (n= 3). All tasks were elicited using verbal prompts. The narrative tasks required participants generate two narratives using Norman Rockwell paintings as picture stimuli. Topics and prompts are summarised in Table 1.

Transcription and coding. Discourse samples were audio-recorded and transcribed into SALT (Miller & Inglesias, 2018). Transcripts were segmented into Communication Units (c-unit), which were defined as any main clause plus any subordinate clauses (Loban, 1976). C-units were coded using standard SALT coding conventions and study-specific measures across micro-linguistic to super-structural levels of analysis.

Micro-linguistic features. Micro-linguistic features included productivity, dysfluency, lexical diversity and morpho-syntactic complexity. Productivity was assessed in total c-units (Loban, 1976). Dysfluency was assessed using total maze words and percent maze words (Westerveld & Vidler, 2016). Lexical diversity was assessed using the number of different words per 50 words of discourse (NDW). Morpho-syntactic complexity was indexed using mean length of utterance in words (MLUw) as well as a measure of clausal density, calculated using total clauses as a proportion of total c-units.

Micro-structural measures. Micro-structural features included cohesive frequency and cohesive adequacy. Cohesive frequency was measured as the total number of demonstrative ties, personal and possessive pronouns and determiners (termed 'referential ties) in each sample (Liles, 1985). This was converted to the referential ties per 50 words of discourse to control for sample length. Lile's (1985) procedure was used to judge each reverential tie as complete, incomplete, or erroneous. Ties were judged as 'complete' when the referent was easily located in preceding utterances. Ties were judged as 'incomplete' when the referent was not provided or was not evident from context. Ties were judged as 'erroneous', if the referent was incorrect or ambiguous. Cohesive adequacy was indexed as the proportion of complete ties of total referential ties.

Macro-structural measures. Macro-structural features included coherence, relevance, and efficiency. Measures of Local and Global Coherence was were calculated using Glosser and Deser's (1990) rating scales. Local coherence refers to the degree to which the current utterance relates to the meaning or content of the preceding utterance and global coherence refers to the degree to which the content of each utterance relates to the overall topic (Glosser & Deser, 1990). Each c-unit received an individual rating along a five-point rating scale. A high local coherence score (5) is provided when the topic of the preceding utterance is continued in the current utterance. A low local coherence score (1) is provided when the current utterance does not relate to the subject or content of the preceding utterance (Glosser & Deser, 1990). A higher global coherence rating (5) indicates that the content of the current utterance provides substantiative information directly relates to discourse topic. A low global coherence score (1) is provided to utterances that are incoherent, and are not related to the discourse topic. An average local and global coherence rating was calculated for each sample. Relevance and efficiency were indexed using Nicholas and Brookshire's (1993) Correct Information Unit (CIU) analysis. A CIU is defined as any word that is intelligible in context, accurate, and relevant to the topic of discourse, stimulus, or prompt (Nicholas & Brookshire, 1993). Relevance was measured as the percentage of CIUs out of total complete words (%). Efficiency of was measured as the number of CIUs produced per minute of discourse.

Super-structural measures. Super-structural measures assessed participants' adherence to the predefined discourse framework for each genre (see Hill et al., 2020 for frameworks). The following measures were used: total Schema Deviations (missing components), total Order Deviations (components are produced out of order to the pre-defined structure), total Genre Shifts (a substantial shift to a different schematic structure), and total Restatements of Question (participants begin their discourse by re-stating the stimuli).

Reliability of transcription and coding

As reported in Hill et al (2020), transcription reliability for 10 percent of samples (16 complete transcripts, inclusive of 176 individual genre samples) transcribed by the first author was measured by two final-year speech-language pathology students, with 98-99% agreement reached between the raters. The coding protocol for the CUDP-A (Hill et al, 2020) was used, drawing from the theoretical literature contributing to the different domains coded in the protocol. Reliability of coding was carried out for 10 percent of samples by the first and second authors. All disagreements were discussed until consensus was reached, and the protocol updated where necessary. Two experienced speech pathologists re-coded a further 10 percent of samples and intra-class correlation coefficients and percent agreement revealed good to excellent reliability for micro-linguistic (.96 to .98), micro-structural (.95 to .99), macro-structural (.76 to. 99), and super-structural measures (.90) (Koo & Mae, 2016).

Statistical Analysis

Descriptive statistics were calculated to summarise language variables across each genre. Topics were collapsed to obtain overall scores for each genre. Multivariate analyses of variance (MANOVAs) were conducted to examine the effect of genre on each variable. Data were also categorised into four age groups 12;0-12;11, 13;0-13;11, 14;0-14;11, and 15;0-15;11 to investigate whether age contributed to genre-related differences. The results of follow-up univariate comparisons are also reported. The assumption of homogeneity was met and adjustments to the degrees of freedom were made in the case of sphericity violations. Normality was not observed for each level of the independent variable due to extreme scores, but MANOVAs are robust to non-normal distributions when sample sizes $N \geq 30$ (Tabachnik & Fidell, 2007). Bonferroni correction was applied to all analyses (p = 0.0125). Effect sizes are reported in partial eta-squared (η_p^2), and interpreted according to Cohen's (1998) conventions where small = .02, moderate = .13, and large = .26.

Results

Genre Effects

All descriptive statistics for each variable across genres are reported in Tables S1 to S4 in supplementary materials. Additional descriptive statistics across age groups are reported in Appendix H. To assist in interpretation of the results, bar graphs with confidence intervals are provided to illustrate differences across genres for micro-linguistic to macro-structural results. Main effects of age on language variables have been published in Hill et al. (2020). As previously reported, analyses revealed no age-related differences across micro-linguistic to super-structural variables reported in this study (Hill et al., 2020).

Micro-linguistic features.

Productivity. Results revealed small, significant, effect of genre on total words, $F(3, 624) = 7.904$, $p<.001$, $\eta_p^2 = .037$. On average, narratives samples were the longest and expository samples were the shortest. Participants produced significantly fewer words in expositions than narrative ($p<.001$, see Appendix H.5), recount ($p<.001$), and persuasive samples ($p=.010$). No significant differences in length were observed between narrative, recount, and persuasive samples. Genre had a moderate effect on the number of c-units, $F(2.17, 338,73) = 22.851$, p < .001, η_p^2 = .128. Numerically, participants produced the most utterances in narratives and the fewest in expositions (Figure 2). Participants' narratives were significantly longer than both expositions, $p < .001$, and persuasive samples, $p = .017$, but were not different to recounts ($p=.270$). Recounts were also significantly longer than expositions and persuasive samples (both p < .001). Expositions were also shorter than persuasive samples (p<.001).

Lexical diversity. A moderate effect of genre on NDW was also observed, $F(3, 624) = 18.114$, p<.001, $\eta_p^2 = .080$. On average, narrative samples contained the widest range of vocabulary while expositions yielded the least lexical diversity. Analysis revealed no difference in NDW between expositions and recount samples (p=.099). Expositions contained significantly fewer NDW than persuasive (p=.002) and narrative samples (p<.001). Narratives also demonstrated significantly greater lexical diversity than recounts (p<.001) and persuasive samples, (p=.003). No difference between recount and persuasive samples was observed (p=.099).

Dysfluency.

large effect of genre on %maze words was found, $F(2.519, 393.012) = 88.05$, p < .001, $\eta_p^2 = .361$. Numerically, narrative samples contained the lowest proportion of maze words, and expositions contained the highest. The proportion of maze words in narrative samples was significantly lower than recount, expositions, and persuasive samples (all p<.001). Expositions yielded a significantly higher %maze words than all other genres (p<.001). Persuasive samples also contained significantly higher number of mazes than recounts (p=.003).

Morpho-syntactic complexity. A large effect of genre on MLUw was found, $F(2.674, 417.139) = 97.244$, p < .001, $\eta_p^2 = .384$. On average, samples of persuasive discourse contained the longest utterances, and recount samples contained the shortest utterances. A significant difference was seen between persuasive and recount samples for MLUw (p<.001). Similarly, recounts contained significantly shorter utterances than expositions (p=.002) and narratives (p<.001). Persuasive and narrative samples did not differ (p = 1.000), yet both contained significantly longer utterances than expositions (both p<.001). Genre also had a large effect on clausal density, $F(2.418, 377.166) = 85.763$, p < .001, $\eta_p^2 = .355$. On average, recounts contained the least complex sentences, and persuasive samples the most (Figure 6). Recounts demonstrated less clausal density than narrative, expository, and persuasive samples (all p<.001). Narrative and expository samples did not differ (p=1.000), but both genres yielded less complex syntax than persuasive discourse (both p<.001).

Table 5.1
Descriptive statistics for micro-linguistic variables across genres (mean, standard deviation, and range)

	Genre							
	Recount		Exposition		Persuasive		Narrative	
Measure	*M(SD)*	*Range*	*M(SD)*	*Range*	*M(SD)*	*Range*	*M(SD)*	*Range*
Total utterances	40.7 (40.52)^{ab}	7 - 234	21.7 (18.35)^{acd}	4 - 143	28 (21.96)^{bce}	6 - 169	34.3 (30.12)^{de}	3 - 219
Lexical diversity NDW per 50 words	21.8(5.3)^{a}	10.2 – 34.5	29.7(21.9)^{c}	2.6 – 142.3	18.1(9.7)^{abc}	1.6 – 80.8	24.1(13.7)^{b}	3.3 – 80.8
Total maze words	21.2(26.5)^{a}	0 - 209	17.2(17.5)	1 - 153	19.9(20.4)^{b}	1 - 169	14.8 (20.3)^{ab}	0 - 146
%Maze words	9.3(4.6)^{abc}	0 - 24	13.5(6.8)^{ade}	1 - 31	10.6(5.3)^{bdf}	1 - 25	6.4(4.9)^{cef}	0 - 31
MLUw	7.8(1.3)^{abc}	4.40 - 11.38	8.6(1.9)^{ade}	4.75 - 13.75	10.7(2.5)^{bd}	5.7 - 18.7	10.4(2.3)^{ce}	6.13 - 19.23
Clausal density	1.1 (.19)^{abc}	.55 - 1.68	1.31 (.26)^{ad}	.57 - 2.57	1.63 (.43)^{bde}	.62 - 4	1.34 (.28)^{ce}	.48 - 3.67

Note: Values with the same super-script letter are significantly different at Bonferroni corrected alpha *p* =.0125.

Table 5.2
Descriptive statistics for micro-structural variables across genres (mean, standard deviation, range)

	Genre							
	Recount		Exposition		Persuasive		Narrative	
Measure	*M(SD)*	Range	*M(SD)*	Range	*M(SD)*	Range	*M(SD)*	Range
Total referential ties per 50 words	3.3(1.4)	1 - 145	31.1(25.7)^{de}	0 - 173	14(13.9)^{acd}	0 - 81	19.9(16.7)^{bce}	2 - 104
Cohesive adequacy (%)	62.8 (24.7)^{ab}	0 - 100	63.2 (33.0)^{cd}	0 - 100	55.1 (27.8)^{ace}	0 - 100	91.1 (16.8)^{bde}	0 - 100

Note: Values with the same super-script letter are significantly different at Bonferroni corrected alpha *p* =.0125.

Table 5.3

Descriptive statistics for macro-structural variables across genres (mean, standard deviation, range)

	Genre							
	Recount		Exposition		Persuasive		Narrative	
Measure	*M(SD)*	Range	M(SD)	Range	M(SD)	Range	M(SD)	Range
Local coherence	3.9 (.42)[ab]	2.3 - 4.8	3.6 (.80)[acd]	nil - 5	3.8 (.48)[ce]	2.3 - 5	4.2 (.48)[bde]	2.9 - 5
Global coherence	4.3 (.43)[a]	3.0 - 5	4.2 (.57)[bc]	2.7 - 5	4.4 (.47)[bd]	248 - 5	4.8 (.28)[adc]	3.3 - 5
%CIU	78.8 (7.80) [ab]	48.4 - 95.5	78.8 (7.80) [cd]	43.6 - 93.7	81.9 (7.92) [ace]	50.5 - 95.6	85.5 (8.03) [bde]	47.4 - 98.9
CIUs per minute	105.8 (29.24)[abc]	24.2 - 147.5	96.0 (28.1)[ad]	20.9 - 152.3	122.6 (29.53)[bde]	30.5 - 186.4	125.0 (33.18)[ce]	27.1 - 254.7

Note: Values with the same super-script letter are significantly different at Bonferroni corrected alpha $p = .0125$. CIU = Correct Information Unit.

Table 5.4

Descriptive statistics for super-structural variables across genres (mean, standard deviation, range)

	Genre							
	Recount		Exposition		Persuasive		Narrative	
Measure	*M(SD)*	*Range*	*M(SD)*	*Range*	*M(SD)*	*Range*	*M(SD)*	*Range*
Schema Deviations	2.6 (2.32)[ac]	0 – 19	3.4 (1.78)[ade]	0 – 9	2.0 (1.68)[df]	0 – 3	1.1 (2.26)[cef]	0 – 26
Order Deviations	.1 (.31)[ab]	0 – 2	.2 (.48)[ac]	0 – 2	.2 $(.49)_d$	0 – 9	.01 (.08)[bcd]	0 – 1
Genre Shifts	n/a	n/a	.3 (.67)	0 – 5	.01 (.16)	0 – 2	n/a	n/a
Restatements of Question	.1 (.26)	0 - 1	.1 (.24)	0 - 1	.01 (.08)	0 - 1	n/a	n/a

Note: Values with the same super-script letter are significantly different at Bonferroni corrected alpha $p = .0125$; 'n/a' = not present in sample.

Micro-structural features.

Cohesive frequency. Genre had a significant, moderate effect on the number of referential ties per 50 words of discourse, F(3, 624) = 25.454, p<.001, η_p^2 = .109. Numerically, narrative samples contained the most referential ties and expository samples contained the fewest. Narrative samples contained significantly more referential ties than all other genres (all p<.001, see Appendix H.6), while no significant differences were observed between expository, persuasive, and recount samples (all p=1.000).

Cohesive adequacy. Genre also had a large effect on cohesive adequacy, F(2.847, 444.174) = 69.581, p < .001, η_p^2 = .308. On average, narratives contained the highest proportion of adequate referential ties, while persuasive samples contained the lowest proportion of adequate ties. Narratives contained a significantly higher proportion of adequate ties than recount, exposition, and persuasive samples (all p < .001). Cohesive adequacy did not differ between recount and persuasive (p=.035) or expository samples (p=1.000). Expositions contained significantly more adequate ties than persuasive samples (p=.009).

Macro-structural features.

Local coherence. Results revealed a large effect of genre on local coherence, F(2.360, 368.208) = 43.232, p < .001, η_p^2 = .217. On average, narrative samples yielded the highest local coherence ratings and expositions the lowest. Local coherence ratings were significantly higher in narrative samples than all other genres (all p<.001, see Appendix H.7). Expositions also had significantly lower local coherence than recount (p<.001) and persuasive samples (p=.003). No difference between recount and persuasive samples was observed (p=.505).

Global coherence. Genre had a large effect on global coherence across samples, F(2.745,428.250) = 70.668, p < .001, η_p^2= .312. Narrative samples received the highest global coherence ratings on average and expositions the lowest. Expositions obtained significantly lower ratings than narrative (p<.001) and persuasive samples (p=.007). Global coherence did not differ between recounts and expository (p=.234) or persuasive samples (p=1.000). Both recount and persuasive samples yielded significantly lower global coherence ratings than narrative discourse (both p<.001).

Relevance. There was a large effect of genre on %CIU, $F(2.832, 441.863)= 47.001$, $p < .001$, $\eta_p^2 = .232$. Numerically, narrative samples contained the highest %CIU, while recount and expository samples shared the lowest %CIU. Narrative samples contained a significantly higher %CIU than recount, explanatory exposition, and persuasive discourse samples (all p<.001). While recount and expository samples did not differ (p=.980), persuasive samples contained a significantly higher proportion of CIUs than both genres (both p<.001).

Efficiency. Genre also had a large effect on CIUpm, $F(2.753, 429.424) = 61.197$, $p < .001$, $\eta_p^2 = .282$. On average, participants were most efficient in narrative discourse and least efficient in expositions. Narratives did not differ in CIUpm from persuasive samples (p=1.000), but both genres yielded significantly more CIUs per minute than expositions (p<.001) and recounts (p<.001). Participants also produced fewer CIUs per minute in expositions compared to recount samples (p<.001).

Super-structural features.

Schema deviations. Genre had a large effect on participants' adherence to pre-defined schemata, $F(2.761, 430.676)= 47.229$, $p < .001$, $\eta_p^2 = .232$. On average, participants deviated from pre-defined schema most frequently in expositions, and least in narrative. Narratives contained significantly fewer deviations than recount, expositions, and persuasive samples (all p<.001, see Appendix H.8). Participants deviated significantly more frequently in expositions than all other genres (all p<.001). No difference was observed between recount and persuasive samples (p=.047).

Order deviations. Genre had a small, significant effect on order deviations, $F(2.344, 365.725)= 47.229$, $p < .001$, $\eta_p^2 = .058$. Numerically, participants changed the order of key schema components least frequently in narratives, and with comparable frequency expository and persuasive samples. No difference between narrative and recount samples (p=.232) was observed. Narratives contained significantly fewer order deviations than expositions (p<.001) and persuasive samples (p=.001). Expositions and persuasive samples did not differ (p=.624). Expositions contained more deviations than counts (p=.007). No difference between recount and persuasive samples was found (p=.624).

Genre shifts. Genre had a small to moderate effect on the number of Genre Shifts in discourse, $F(1.101, 171.757) = 18.318$, $p < .001$, $\eta_p{}^2 = .105$. Overall, genre shifts occurred infrequently across samples. Almost all genre shifts occurred in expositor samples, with no incidences documented in recounts and narratives. Expositions contained a significantly greater number of shifts than all other genres (all $p<.001$). No differences between recount, narrative and persuasive samples were observed (all p = 1.000).

Restatements of question. Genre also had a small effect on the number of RSQs in discourse, $F(1.975, 308.148)= 6.583$, $p = .002$, $\eta_p{}^2 = .033$. Numerically, RSQs occurred in expository and recount samples, while narratives contained no restatements or clarifications of topic. Recounts contained significantly more RSQs than narratives ($p=.002$) and persuasive samples ($p=.005$). Recounts did not differ from expositions ($p=1.000$). Expositions did not differ from persuasive samples, but contained significantly more RSQs than narratives ($p=.015$). No difference between narratives and persuasive samples was found ($p=1.000$).

Interaction Between Genre and Age

No age*genre interaction effect was observed for micro-linguistic, $F(45, 3120) = .433$, $p=1.000$, $\eta_p{}^2 = .006$)=.416, $p = 1.000$, $\eta_p = .006$; micro-structural, $F(18, 936) = .666$, $p = .846$, $\eta_p = .013$; macro-structural, $F(36, 1872) = 1.047$, $p = .393$, $\eta_p = .020$; or super-structural variables, $F(36, 1872) = .807$, $p = .787$, $\eta_p = .015$. Descriptive statistics for each age group and genre for each level of analysis are set out in Appendix H.

Discussion

This study investigated variability in adolescent discourse skills across four monologic genres that are frequently encountered in the social and academic contexts of adolescence. This study examined differences in a comprehensive range of word to whole-text level language measures across samples or recount, narrative, expository, and persuasive discourse and examined the extent to which genre interacted across the age groups in the study. It was anticipated that comparing adolescents' language skills across a range of monologic tasks may identify those that are more informative than others, potentially enhancing the feasibility of discourse assessment in clinical practice and, importantly, to guide intervention planning. Consistent with past studies of discourse in younger children and adolescents, participants in this study produced the longest, most fluent, cohesive, and coherent discourse in narrative tasks while expository discourse samples demonstrated the shortest, most error prone, least cohesive and coherent linguistic output (e.g. Lundine et al., 2018). Our results are largely consistent with current discourse models and the notion that bottom-up processing mechanisms in event-based tasks support optimal language performance via a well-consolidated knowledge of story grammar. In contrast, tasks that draw on top-down mechanisms to retrieve and plan language related to abstract, fact-based information elicit more variable discourse skills due additional cognitive-linguistic demands (Berman & Nir-Sagiv, 2007). Taken together, the results of this study suggest that adolescent discourse skills are influenced by genre, and that this may be explained via the association between domain-specific knowledge, structure, and content that occurs during discourse processing.

Genre-related Differences in Adolescent Discourse Skills

One possible explanation for our observation of more optimal language output in narrative samples may be attributed to familiarity and early exposure to narrative story grammar (Lundine et al., 2018). The participants demonstrated a consolidated knowledge of story grammar, evidenced in observations of infrequent deviations from the pre-defined narrative schemata. In accordance with current models of discourse processing, these results may indicate that participants' stored knowledge of story grammar may have alleviated cognitive-linguistic demands, which were then allocated to topic maintenance and ensuring the logical and efficient flow of accurate information within, and between, utterances (Hickman, 2004; Makinen et al., 2014). Narrative tasks may provide an optimal context for adolescents to demonstrate proficiency across a range of word to whole-text level language features. A well-consolidated stored representation of narrative structure directly informs word and sentence-level language encoding via bottom-up processing mechanisms(Berman & Nir-Sagiv, 2007).

The observation of less optimal discourse output in recount tasks compared to narrative samples was unexpected as recounts contain personally relevant information, occur earlier along the oral to literate continuum and in the academic curriculum (Bliss & McCabe, 2012).The observation of variable super-structural profiles between recount and narrative was surprising as they share similar features such as the requirement of orientating contextual information and an event-based structure. Our results do, however, support earlier research with younger children where the structure of personal recount samples has not mapped onto prototypical narrative story grammar (Aksu-Koc & Aktan Erciyes, 2018). Although they are both event-based tasks, the flexibility in structure of recount versus narrative discourse may reflect the more formal, literature nature of fictional narratives (Bliss & McCabe, 2012). Adolescents may also have less concrete representation of recount structure stored in memory as this genre is rarely directly taught or assessed in middle to high school years. An interpretation based on models of discourse processing would suggest that variability in super-structural profiles accounts for differences between narrative and recount tasks at micro-linguistic to macro-structural measures.

A finding of particular interest was the low cohesive adequacy in recounts compared to narrative texts. Narratives elicited the greatest cohesive adequacy, which reflects participants' adherence to story grammar as well-formed stories necessitate the use of pronouns and determiners to introduce and maintain characters, settings, events, and the temporal, causal, and adversative links between them (Fichman & Atman, 2019). Recounts are regarded, however, as requiring the same use of pronouns and determiners to introduce, and relate, key people, locations, and events as narrative discourse (Hickman, 2004). It is possible that participants' subversion of story grammar in recounts may influence the need to provide adequate referential ties. Th referential ambiguity observed in recount may relate to the content of the CUDP-A prompts, where participants carried over specific first mentions provided by the assessor. Interestingly, this may also have occurred in expository and persuasive tasks. The use of inadequate referential ties may also relate to the informality of oral discourse assessment where adolescents used non-specific pronouns in lieu of specific mentions to maintain a quasi-natural flow of interaction in an informal discourse task (Lindgren & Vogels, 2018). In contrast, narrative being a more literate, formal genre may retain the requirement for specific first mention in oral tasks (Westby, 2014). Another possible interpretation relates to egocentricity in adolescent development where participants may have selected referential based on their own perspective and inaccurate judgments of necessary information (Gundel & Johnson, 2013). Lile's (1985) procedure for assessing cohesion in discourse originated from the study of narrative genres. Perhaps findings of low cohesive adequacy in recount, persuasive, and expository samples signal the need to adapt analysis of cohesion for different genres.

The observed similarities between language profiles in recount and persuasive discourse was also an unexpected finding as, theoretically, recount and persuasive discourse lie on opposite ends of the oral to literate continuum (Westby, 2014). Persuasive samples did, however, yield the greatest morphosyntactic complexity across samples, which is consistent with the notion that persuasion involves expression of complex thoughts through sophisticated language structures (Nippold, 2007). It was interesting to observe that many participants used personal recounts along with, or often in place of, fact-based information to support their opinion. This may account for similarities between persuasive and recount samples across micro-linguistic to macro-structural variables and supports the assertion of Berman and Nir-Sagiv (2007) that adolescents tend to subvert generic structures by "transplanting elements of one genre into another" (p. 104). The oral persuasive genre allowed participants to produce more egocentric, personally familiar and relevant content as adolescent are able to refer directly to themselves and their own opinion. Persuasive discourse is a complex task that would require top-down processing, so participants may have reduced cognitive-linguistic demands by drawing more heavily on bottom-up processing and switching to event-based structures or more familiar content (Berman & Nir-Sagiv, 2007).

This strategy may be less appropriate in expository discourse, causing expositions to yield less optimal language profiles than persuasive tasks for this sample. For instance, adolescents' expositions demonstrated the least stringent adherence to pre-defined schemata, which is consistent with the notion that fact-based tasks place greater demands on global text organisation due to a reliance on declarative knowledge. In their study of adolescents' written discourse, Berman and Nir-Sagiv (2007) attributed poorer global organisation of expository texts to the extent of general knowledge and exposure to schematic structure, highlighting that "parents read storybooks, not compositions or encyclopaedias to their infants, and school children watch movies, not documentaries, on television" (Berman & Nir-Sagiv, 2007, p. 107). In accordance with theories of discourse processing, limited knowledge related to the topic of discourse would account for the difficulties in global text structure as well as reductions in coherence and cohesion, length, fluency, and lexical diversity observed in this study (Frederiksen & Stemmer, 1993), particularly as the expository prompt requested an explanation or description of the topic (Hill et al., 2020). It may have been difficult for participants to retrieve and encode micro-linguistic to macro-structural discourse features in order to communicate information effectively if they could not access adequate domain-specific knowledge in real time (Berman & Nir-Sagiv, 2007). Interestingly, observation of comparable clausal density in expository and narrative tasks contradicts the results of studies in younger school-age children (e.g. Scott & Windsor, 2000) and studies of written discourse in adolescence (Brimo & Hall-Mills, 2019). It is possible that limited declarative knowledge also restricted use of complex syntax to express complex ideas in expositions. The results may also support an interaction between genre and modality (Brimo & Hall-Mills, 2019), or a transition to more sophisticated adult-like across both genres.

Results indicated a significant influence of genre on micro-linguistic to super-structural features irrespective of age. This supports previous evidence of a consolidation of the ability to plan and produce distinguishable discourse genres at an early age (Berman & Nir-Sagiv, 2007). This has important implications for clinical and academic assessment of discourse skills across middle to upper school years, where clinicians and educators may assume competence, or otherwise, in oral discourse on the basis of a limited range of genre in the academic curriculum.

Clinical Implications

The CUDP-A (Hill et al., 2020) was found to be a useful tool to elicit distinguishable discourse samples across four monologic genres. A significant effect of genre was found on every language feature measured across micro-linguistic to super-structural levels of analysis, with moderate to large effects observed across the majority of CUDP-A measures. No single genre is likely to elicit an individual's range of strengths and weaknesses in discourse skills. Assessment of a range of discourse genres that reflect the everyday communication contexts of adolescence is needed, particularly given clinicians report a preference for narrative assessment over other discourse forms (Westerveld & Moran, 2011). In summary, the results support the assertion of Liles et al. (1989) that tasks which draw on abstract or less familiar information challenge discourse-level language skills. Narrative tasks may be valuable to profile strengths in discourse, yet basing interpretation solely from narratives may overestimate competence in word to whole-text level features of other genres. For instance, persuasive tasks provides a context in which to sample adolescents' use of complex syntax. Expository tasks appeared to pose the greatest challenge for participants in this study, yet it is not possible to conclude whether this is due to linguistic demands or variable domain-specific knowledge. Declarative knowledge is a critical consideration when assessing fact-based genres, particularly given it is largely determined by social, cultural, and economic factors (Berman & Nir-Sagiv, 2007). Clinicians may wish to make additional efforts, where possible, to select salient and relevant topics when assessing discourse skills.

Limitations and Future Directions

Conclusions could be strengthened by recruiting a larger sample, with a wider age range and greater cultural and linguistic diversity, to ensure even greater representation of the mainstream cohort. The four monologic genres assessed using the CUDP-A were chosen based on their relevance to social pursuits and presence in the curriculum. Despite this, dialogic conversational discourse and other monologic genres such as procedures, descriptions, narrative retell, and other forms of expository discourse would be valuable areas for further investigation. Ongoing investigation of differences between monologic and dialogic discourse would further enhance understanding of the pragmatic, cultural and linguistic factors associated with discourse skills (Nippold, Frantz-Kaspar, Cramond, & Kirk, 2014) . As this study did not explicitly test domain knowledge, it is difficult to determine whether topic complexity, prior knowledge, or other factors constrained discourse performance. Ongoing attention should be paid to understanding the underlying factor(s) that contribute to genre-related differences in discourse skills, such as processing requirements, topic knowledge, context, or pragmatic requirements. It is important to highlight that the CUDP-A scoring protocol defines schematic structures on the basis of Australian curriculum resources and theory relating to literature and written discourse. Our results may reflect differences in the structural and content requirements of informal oral and formal written discourse. Brimo and Hall-Mills' (2019) work may assist in examining the interaction of genre and modality on adolescent discourse across a range of word to whole-text features

Conclusions

This study has addressed an important gap in our understanding of the influence of genre on adolescent discourse. Past studies of inter-genre variation have examined predominantly younger school-age children on a limited number of genres using narrow sets of word and sentence-level measures. This study compared adolescent discourse skills across four monologic discourse genres that are frequently required in social and academic contexts. Overall, the results suggest that genre has a significant influence over adolescents' spoken discourse and that this is likely related to a link between declarative knowledge, structure, and content. Participants' performance varied according on stored representations of discourse structure and the demands placed on retrieval and organisation of familiar versus abstract content, regardless of age. A well-consolidated knowledge of narrative structure may support adolescents to demonstrate optimal language proficiency across word to whole-text level language measures. In contrast, fact-based tasks, particularly expository discourse, may place additional demands on declarative knowledge and bias adolescents to demonstrate less competent language skills in discourse assessment. This has implications for assessment and intervention planning in clinical populations as the majority of available standardised language assessments narrowly target narrative discourse, which may not reflect an individual's competence across other forms of discourse. These findings suggest that clinicians obtain a profile of strengths and weaknesses in discourse by sampling skills in genres that involve top-down and bottom-up discourse processing, explicitly considering the influence of declarative knowledge on assessment performance. In promoting a more comprehensive identification of discourse impairments, the selection of appropriate goals and targets for intervention are likely to follow.

General Conclusions of Part Two of this Research Program

The ultimate objective of this thesis was to explore links between discourse skills, cognitive function, and psychosocial health in adolescents with ABI. Thus far, the program of research has addressed the interim aims of Parts One and Two of this thesis. The results of Part One highlighted the lack of age-appropriate discourse assessment tools and normative data for adolescents that are available to clinicians and researchers to identify and describe level(s) of breakdown in adolescents with brain injury. This relates to a limited understanding of the nature and correlates of discourse in adolescents with ABI. These caveats were addressed in Part Two of the research program, which presented the CUDP-A and an analysis of corresponding reference data of adolescents without ABI across an array of language features. Together, Parts One and Two have contributed to an enhanced understanding of discourse in adolescents with and without ABI and provided a novel assessment of adolescent discourse and reference data available for empirical research and clinical practice.

Drawing on the outcomes of Studies 1 to 4, the aim of Part Three was to explore the cognitive and psychosocial factors associated with discourse-level language features in adolescents with and without ABI and determine the utility of the CUDP-A as an assessment of spoken discourse for use with adolescents with cognitive-communication deficits following ABI.

PART THREE

Cognitive and Psychosocial Correlates of Spoken Discourse in Adolescents with and without ABI

Chapter 6
Cognitive and Psychosocial Correlates of Spoken Discourse in Adolescents without ABI

Chapter Overview

Discourse lies "at the crossroads of language and cognition" (Lê et al., 2011, p.19) and is proposed to be critical for social skills and mental wellbeing in adolescents (Turkstra, 2000). MacDonald's (2017) model also depicts a clear link between the domains of cognition, communication, and psychosocial health in speakers with brain injury. Consequently, an awareness of the cognitive skills and aspects of psychosocial health that are related to discourse skills is considered critical for clinical decision-making for adolescents with ABI (Togher et al., 2014). Despite this, little is known about the relationship between cognitive, discourse, and psychosocial domains that exists typically in adolescence.

The current chapter (Study 5) presents an exploration of the cognitive and psychosocial factors associated with spoken discourse features within the reference sample collected as part of Part Two of this doctoral research. The systematic review (Study 1) documented consistent evidence of a relationship between cognition and discourse in speakers with ABI; albeit predominantly in adults. The relationships observed across studies were largely consistent with Gernsbacher's (1990) SBF, which was initially designed to account for discourse processing in typical populations. An ABI is hypothesised to disrupt the manner in which discourse typically subserves discourse production (Coelho, 2007). As a result, we predict significant correlations between performance on measures of cognitive function and discourse-level language. As discussed in Chapter 1, past studies have observed significant relationships between discourse impairments and poor psychosocial outcomes in adult and paediatric ABI (Aguilar et al., 2019; Elbourn et al., 2019). The ability to communicate competently is important for social and academic participation and success in adolescence, in general (Nippold, 1998; Turkstra, 2000). Subsequently, we hypothesise a significant relationship between performance on psychosocial health tasks and discourse-level language. Given the empirical and theoretical support for the role of these processes in spoken discourse, we predict a significant relationship between participants' performance on cognitive and spoken discourse tasks across each level of discourse analysis (i.e. micro-linguistic, micro-structural, macro-structural, and super-structural).

Method[13]

Participants and Procedure

This study draws on the same adolescent reference sample recruited in Study 3; assessment procedures have also been previously described (see page 97). Alongside spoken discourse and oral language assessment, we also administered a battery of cognitive and psychosocial measures in the second 60-minute assessment session. The complete assessment battery is summarised in Table 6.1.

Table 6.1

Battery of language, cognition, and psychosocial health assessments

Measure	Target construct	Outcome measure
Language and discourse variables		
CELF-4	Oral language skills	Core Language Score
CUDP-A	Spoken discourse	See Appendix F.2
Cognitive variables		
CELF-4 Number Repetition	Working memory capacity	Subtest scale score
N-back Test	Updating in working memory	Net total score
D-KEFS Trail-making Test	Shifting	Time difference (ms)
Stop-signal Task	Inhibition	Stop-signal reaction time
D-KEFS Tower Test	Planning	Move accuracy ratio
RAVLT Immediate	Short-term verbal memory	Total recalled
RAVLT Delayed	Delayed verbal memory	Total recalled
BRIEF-2 Parent Screen	Daily executive behaviour	Total score
Psychosocial variables		
LCQ	Perceived communication competence	Total score
PedsQL Self-Report	HRQoL	Physical Health, Psychosocial, and Total Health summary scores
PedsQL Parent-report	HRQoL	As above
CASP	Daily participation	Total Summary Score
MFAD	Family functioning	Individual subscale scores

Assessments of Cognitive Function

Selection of cognitive constructs and assessment tools was informed by the systematic review (Study 1). All assessment tools have been recommended for use in

[13] See Appendix A for additional methodological details.

clinical practice and empirical research in paediatric ABI (Hicks et al., 2013; Miller et al., 2012; Wilde et al., 2010).

Planning. Planning encompasses our ability to formulate, evaluate, and select a sequence of thoughts and/or actions required to achieve a goal, and is attributed to global coherence, efficiency and informativeness, as well as the overall structure of discourse output (Gross et al., 2010; Hill, Claessen, Whitworth, Boyes, & Ward, 2018). The Delis-Kaplan Executive Function System (D-KEFS) Tower Test was administered as an assessment of planning (Delis, Kramer, Kaplan, & Ober, 2001). The D-KEFS Tower Test (Delis et al., 2001) has demonstrated construct validity, satisfactory internal consistency (α =.50 to .61) and test-retest reliability (r=.51; Delis et al., 2001). The measure obtained from the Tower Test was the Move Accuracy Ratio (MAR). The MAR reflects the proportion of total moves made by the participant relative to the total minimum moves required to solve each item (Delis et al., 2001). The MAR assesses the degree to which participants use effective, or ineffective, strategies to complete each item, which has demonstrated clinical utility in detecting executive difficulties in children and adolescents (Locascio, Mahone, Eason, & Cutting, 2010). Administration time for The Tower Test was approximately 15 minutes.

Set shifting. Set-shifting refers to the ability to adapt behaviour to changing stimuli (Ravizza & Carter, 2008). The systematic review documented evidence of a relationship between set shifting and local coherence, efficiency of information transfer, and the structural organisation of discourse in speakers with ABI. The D-KEFS Trail-making Test Condition 3 (Letter Sequencing) and Condition 4 (Switching) were administered to measure set shifting. In adolescents, the D-KEFS Trail-making Test Conditions 3 and 4 composite score has demonstrated construct validity, internal consistency (α =.68 to .72), and test-retest reliability (α =.78; Delis et al., 2001). Participants were timed during both conditions. A Combined Number-Letter Sequencing Composite Score was calculated for each participant (Delis et al., 2001; Kortte, Horner, & Windham, 2002). This was calculated by subtracting the Condition 3 Scale Score from the Condition 4 Scale Score. The Contrast Score has successfully distinguished individuals with and without executive dysfunction resulting from ABI (Lange, Iverson, Zakrzewski, Ethel-King, & Franzen, 2005). Completion time for the Trail-making Test was 10 minutes.

Updating in working memory. Updating is a key executive behaviour that underpins higher-level executive functions, namely the ability to hold and manipulate information in working memory (Miyake et al., 2000). Chapter 2 documented a link between updating and the ability to determine and monitor changing lexical representations in discourse (Coelho, 2012). The N-back Task with Letter Stimuli (Jaeggi et al., 2010)from Millisecond Software (2015) was used to measure updating in this study. This task was administered using the researcher's laptop using Millisecond's Inquisit 4 Lab (Inquisit, 2015). This version of the N-back Task is based on the single-task version of the N-back procedure as described by Jaeggi et al (2010). The N-back Task has, however, demonstrated empirical utility in detecting deficits in updating and executive function following adult and paediatric ABI (Chapman et al., 2006; Levin et al., 2002; Owen, McMillan, Laird, & Bullmore, 2005). The computerised N-back Task consisted of three levels of memory load ('*n*-back load'; 1-back, 2- back, 3-back). An additional 0-back condition was also included to control for task attention whilst imposing minimal load on memory (Jaeggi et al., 2010). As in Chapman et al (2006), a net percent score of each level of n-back task was calculated as a measure of updating. This was calculated as the participants' total correct responses expressed as a proportion of total trials (Jaeggi et al., 2010). This calculation removes the potential for a participant to obtain a perfect score by striking the key on all trials (Levin et al., 2002). This measure also allows for comparison to individuals with ABI due to its consideration of poor inhibitory control frequently observed in this population (Chapman et al., 2006). Administration time for this task was 15 minutes.

Inhibitory control. Inhibitory control is the cognitive suppression of automatic responses (Miyake et al., 2000). The results of the systematic review (Chapter 2) indicated a link between inhibition and cohesive adequacy, global coherence, and topic maintenance in discourse following ABI (Lê et al., 2014; Marini et al., 2017). In this study, inhibitory control was assessed using the Stop-Signal Task (SST) available through Millisecond Software. The SST was also run via Inquisit 4 software (Inquisit, 2015) on the researcher's laptop. Past studies have observed this task to have fair to excellent reliability as measured by ICCs of r=.42 to .86 (Congdon et al., 2012; Soreni, Crosbie, Ickowicz, & Schachar, 2009). The SST paradigm has demonstrated its validity in children and adolescents with known impulse deficits such as those with attention-deficit hyperactivity disorder and ABI (Ornstein et al., 2013; Soreni et al., 2009). Participants' inhibition was indexed using stop-signal reaction time in milliseconds (SSRT). SSRT is an estimation of the time required for the participation to inhibit their reaction, with slower SSRT indicating difficulty with inhibitory control (Logan, 1994). Each participant's SSRT was calculated automatically by the computer program using the 'subtraction method' (Logan, 1994). This method assumed participants successfully inhibited their response on 50% of go trials. Where participants inhibited their response on significantly more or less than 50% of trials, SSRT was calculated using the integration method (Logan, 1994; Verbruggen et al., 2019). Completion time for the SST was approximately 15 minutes.

Working memory capacity. Working memory capacity refers to the cognitive space available for manipulation and temporary storage in working memory (Baddeley, 1992; Wilhelm, Hildebrandt, & Oberauer, 2013). Chapter 2 described links between working memory capacity and structural organisation of discourse content, adequacy of use of cohesive ties, topic maintenance, and coherence. The Number Repetition subtest of the CELF-4 (Semel et al., 2003) was administered to assess working memory capacity. The CELF-4 Number Repetition subtest has demonstrated good internal consistency across Forwards (α =.75) and Backwards (α =.78) components as well as overall (α =.78; Semel et al., 2003). Each participant's Number Repetition scale score was recorded. The administration time for this task was approximately five minutes.

Daily executive functioning. Children and adolescents can exhibit dichotomous performance on formal, standardised measures of executive function, and in their completion of daily tasks that draw on executive behaviour (Chaytor, Schmitter-Edgecombe, & Burr, 2006; Gioia & Isquith, 2004). One parent of each participant completed the Behaviour Rating Inventory of Executive Function, Second Edition (BRIEF-2) Parent Report Screening Form (Gioia, Isquith, Guy, & Kenworthy, 2015) as a measure of their child's daily executive functioning. The BRIEF-2 has demonstrated clinical and empirical utility as an ecologically valid measure of executive functioning (Chapman et al., 2010; Chevignard et al., 2009; Gioia & Isquith, 2004). The BRIEF-2 Parent Screening Form is a condensed questionnaire that is appropriate for use in research where reduced respondent burden is prioritised and a global ecologically valid estimate of executive function is desired (Gioia et al., 2015). The BRIEF-2 Parent Screening Form matches the internal structure and sensitivity of the full BRIEF-2 to global executive function, and has proven internal consistency (α = .85 to .89), inter-rater reliability (r=.64 to .80) and test-retest reliability (r=.79 to .87; Gioia et al., 2015). Performance on the BRIEF-2 Screening Form also correlates significantly with scores on widely used rating scales of executive behaviour and successfully discriminated between respondents with and without executive dysfunction (Gioia et al., 2015). The questionnaire consists of 12-items that survey parents' perspectives on their child's behavioural regulation, task completion, and attention span. This results in a total raw score, which is compared to an age- and gender-normed cut-off score indicating clinically elevated executive difficulties (Female: 11 to 13 years = 22; 14 to 17 years = 19; Male 11 to 13 years = 22; 14 to 18 years = 20; Gioia et al., 2015). Administration time for the BRIEF2 Screening Form was five minutes.

Verbal memory. The results of Chapter 2 indicated the role of verbal memory in the retrieval of appropriate information in discourse, and the accurate association of that information to previously expressed idea through lexical devices, such as the logical and/or temporal links between events or people (Cohen & Banich, 2003). Each participant completed the Rey Auditory Verbal Learning Task Immediate and Delayed Recall (RAVLT) (Schmidt, 1996) as measures of verbal memory. The RAVLT is recommended as a measure verbal memory in paediatric ABI, and is used extensively in the literature examining memory functioning in individuals with and without brain injury (Marini et al., 2011; Marini et al., 2017; McCauley et al., 2012). The RAVLT Immediate Recall score has demonstrated good test-retest reliability, r=.67 to .84 (Geffen, Butterworth, & Geffen, 1994), as has the Delayed Memory score, r =.66 to .81, (Uchiyama et al., 1995). The RAVLT has also shown and criterion validity, loading onto other verbal memory and general memory measures (Schmidt, 1996). For Immediate Recall, total words recalled from Trials I-V was recorded. After a 20-minute delay, during which other cognitive tasks were administered, participants were asked to recall List ‘A’ items and the total was recorded as the Delayed Recall score (Schmidt, 1996). Administration time for the RAVLT was 15 minutes.

Assessments of Psychosocial Health

Psychosocial health was separated into four constructs: HRQoL, daily participation, family function, and perceived communication competence. These constructs were chosen to align with those included within MacDonald's (2017) model of cognitive-communication.

Health-related quality of life. HRQoL was assessed using the Paediatric Quality of Life Inventory (PedsQL) Generic Core Scales, Parent and Self-reports (Varni, Seid, & Kurtin, 2001). The PedsQL Generic Core Scales measure the core dimensions of health as defined by the World Health Organisation (WHO, 1948). There are four multidimensional scales (physical, emotional, social, and school functioning) and three summary scores (physical health, psychosocial health, and a total summary score; Varni et al., 2001). The PedsQL Core Scales have been used extensively in studies of psychosocial outcomes post-injury (Erickson et al., 2010; McCarthy et al., 2005; McCauley et al., 2012). The PedsQL Total scale score and summary scores have demonstrated acceptable internal consistency (α=.80 to .90) and construct validity. The tool has distinguished HRQoL in healthy children and adolescents and those with acute and chronic health problems (including ABI) and scores correlate with measures of morbidity and burden of illness (Varni et al., 2001). Parent- and self-report Physical, Psychosocial, and Total Health summary scores were obtained for each participant. Administration times for the PedsQL (Varni et al., 2001) Parent and Child reports were 15 minutes and five minutes, respectively.

Daily participation. The Child and Adolescent Scale of Participation (CASP) (Bedell, 2004) parent questionnaire was administered as a measure of each participant's daily participation. The CASP has been used extensively to examine quality and quantity of participation in children with ABI (Bedell & Dumas, 2004; McCauley et al., 2012; Ziviani, Desha, Feeney, & Boyd, 2012). The CASP is a 20 ordinal-item scale that consists of four sections that cover parents' perspectives of their child's involvement in play and leisure activities with family, involvement in structured events and activities in the community, communication with other children and adults at school, and management of daily schedules (Bedell, 2004). Most recent psychometric testing of the CASP was conducted across 313 primary caregivers, and demonstrated strong test-retest reliability (*ICC*=.94), internal consistency (α =.96), and construct and discriminant validity (Bedell, 2009). Parents rated their child's level of participation relative to other children their age on a four-point scale: 'Age Expected' (assigned score 4), 'Somewhat Limited' (assigned score 3), 'Very Limited' (assigned score 2), 'Unable' (assigned score 1), or 'Not Applicable' (assigned score 0). A "Not Applicable" response occurs when participation is not expected due to factors such as age (e.g. work participation; Bedell, 2004). A CASP Total Summary Score was obtained for each participant. Administration time for the CASP was approximately 5 to 10 minutes.

Family functioning. Communication competence is a significant contributor to successful family dynamic and overall functioning (MacDonald, 2017). Each parent completed The McMaster Family Assessment Device (FAD); a 60-item questionnaire based on the McMaster Model of Family Functioning (FAD) (Epstein, Baldwin, & Bishop, 1983). The FAD obtains scores across six dimensions of family functioning (Epstein et al., 1983). *Problem Solving* describes the family's ability to resolve conflict. *Communication*, describes how the family shares and receives information. *Roles* explores the degree to which roles are established and family members perform behaviours that fulfil that role. *Affective Responsiveness* assesses the family's ability to respond to provocations with appropriate emotions. *Affective Involvement* describes the degree to which family members engage with others' interests and emotions. *Behaviour Control* captures the degree to which family members appropriately manage problem behaviour. *General Functioning* represents abilities across each domain. In each subscale, participants rate their agreement on a number of statements on a 4-point scale (1 = strongly disagree, 4 = strongly agree). A higher score indicates higher family functioning for five test items and lower family functioning for six items, which are reverse coded for analysis (Epstein et al., 1983). The FAD has demonstrated good internal consistency for individual subscales (α=.72 to .83) and general functioning scores (α =.92) (Nelson et al., 1989), as well as test-retest reliability (r=.66 to .76) and concurrent, discriminative, and construct validity (Miller et al., 1985). Each participant obtained an individual subscale score and general functioning summary score. Administration time for the FAD was 5 minutes.

Perceived social competence. The La Trobe Communication Questionnaire (LCQ) (Douglas, Bracy, & Snow, 2007) was completed by each participant as a measure of self-perceived communication competence. The LCQ has successfully differentiated individuals with and without self-perceived communication deficits following ABI (Douglas, 2010; Struchen et al., 2008). The LCQ was originally designed for use with the adult population, yet has proven clinical utility with adolescents with and without a history of ABI (Douglas, 2010). The questionnaire has demonstrated high internal consistency in young adults with ABI (α=.91) and without (α =.85) and test-retest reliability in young adults with (r=.81) and without (r=.76) history of brain injury (Douglas; 2010). The LCQ consists of 30 items that reflect each domain of Grice's (1975) Cooperative Principles of Conversation (quantity, quality, relation, and manner) and common communication difficulties following ABI. A higher score indicates greater perceived communication difficulty. As in Douglas (2010), no changes to the questionnaire were made for use with adolescents in this project. Each participant obtained a total score. Administration time for the LCQ was 10 minutes.

Statistical Analysis

Statistical analyses were conducted in five stages. First, a missing values analysis was conducted and missing data were imputed using complete-case analysis (Garson, 2014). Second, descriptive statistics for all variables of interest were calculated to describe performance on cognitive, language, and psychosocial assessments. Third, multivariate analyses of variance (MANOVAs) were undertaken to examine age-related differences on cognitive and psychosocial variables (age effects on discourse and language measures are presented in Chapter 4). To reduce risk of Type One error, a Bonferroni correction was made to the alpha level (α = .0125, .05/4) for omnibus and follow-up tests. Fourth, given the limited sample size, a series of principal component analyses were conducted to reduce the number of variables to their underlying factors. Finally, a series of hierarchical regression analyses were conducted to further examine the association between cognitive function, spoken discourse, and psychosocial health. To allow for plotting of data and reduce potential co-linearity, all predictor variables were standardised (Tabachnik & Fidell, 2007). For significant interaction simple slopes analyses were conducted to probe the nature of relationship between criterion variables and outcomes at both high (+1sd) and low (-1sd) levels of the moderator (Aiken & West, 1991).

Results

Performance across Tasks

Descriptive statistics summarising performance on the CUDP-A are reported in Chapter 4, and scores on cognitive and psychosocial health tasks are summarised in Appendix I.1.

Age Effects

Across all areas of assessment (cognitive function, discourse, and psychosocial health), multivariate analyses revealed an effect of age on cognitive assessments only, $F(24, 450) = 1.943$, $p=.005$, $\eta_p^2 = .09$. Specifically, age groups ($N=4$) differed on the BRIEF-2 Screening Form, $F(3, 155) = 4.775$, $p=.003$, $\eta_p^2 = .09$, with the 15-year-old age group obtaining lower scores than the 12-year-old group, $p=.005$. No age effects on psychosocial variables were observed, $F(39, 429) = 1.025$, $p=.433$, $\eta_p^2 = .08$, and, as reported in Chapter 4, age groups did not differ on measures of oral language skills or spoken discourse (see page 102). As the BRIEF-2 was the only assessment to differ across age groups, age was not controlled for in subsequent analyses.

Correlational Analysis

The results of univariate correlational analyses between oral language and spoken discourse were previously described in Chapter 4 (see Appendix G.2). Overall, the results of univariate correlations between cognitive function and discourse (see Table 6.2) supported predictions, with performance across executive function and verbal memory variables correlated with multiple discourse measures across micro-linguistic to super-structural levels of analysis. Results also confirmed the presence of specific significant associations between discourse and psychosocial variables (see Table 6.3), providing partial support for predicted relationships between these domains of function. The results of correlational analyses between cognitive and psychosocial variables are reported in Appendix I.2.

Table 6.2.
Bivariate correlations between discourse and cognitive variables.

Level of analysis	CUDP-A variable	Number Repetition	N-back	Stop-signal	Tower Test	Trail-making	BRIEF-2	RAVLT Imm.	RAVLT Del.
Micro-linguistic	Total c-units	**.19***	**.16***	-.07	-.12	-.06	.04	**.19***	**.27****
	MLUw	-.03	.13	.04	**-.24***	-.14	-.12	**.16***	-.01
	Clausal density	-.10	.08	-.03	-.06	-.15	.05	.13	-.03
	Total maze words	.13	.13	.05	**.16***	-.02	.01	.14	**.21***
	%Maze words	.01	.03	.07	-.08	.08	.02	-.07	-.01
	NDW	**.19***	.20	-.09	**-.16***	-.10	-.01	**.26****	**.29****
Micro-structural	Total referential ties	**.17***	.13	-.10	-.11	-.10	-.04	**.23***	**.25****
	Cohesive adequacy (%)	.10	.14	-.02	**-.22***	.05	-.07	**.25***	**.25****
Macro-structural	% CIUs	.01	.04	-.10	.07	-.11	.03	.06	.05
	CIUs per minute	.01	.07	.02	**-.17***	-.14	.01	.01	.02
	Local coherence	.01	.15	.04	-.01	.08	.04	-.06	.04
	Global coherence	**.16***	-.04	.02	-.01	-.05	-.03	.04	.01
Super-structural	Schema deviation	**-.27****	.18	-.07	-.15	-.03	.09	.05	.07
	Genre shift	.10	.10	-.01	-.11	.07	.11	.07	.12
	Order deviation	.01	.09	.02	.04	-.10	-.08	.14	.12
	Restatement of Question	**-.33****	.13	-.03	-.02	.06	-.14	.09	.01

Note: Bolded values are significant at *p<.05 ** p<.001. MLUw = mean length of utterance (words); CIU = correct information unit

Table 6.3

Bivariate correlations between discourse and psychosocial variables

Level of analysis	CUDP-A variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Micro-linguistic	Total c-units	-.06	.01	-.02	-.04	.06	.04	-.13	-.05	-.07	-.15	.01	-.03	-.06	.12	-.07
	MLUw	-.05	-.04	-.05	**-.20***	-.13	**-.17***	.01	.08	.09	.02	-.07	.10	-.03	.01	-.13
	Clausal density	-.05	-.08	-.08	**-.17***	-.11	-.14	.15	.07	.05	.14	.07	.11	.06	.01	.03
	Total maze words	-.11	.02	-.03	.02	.07	.07	-.10	-.01	-.08	-.07	-.02	-.02	-.03	.08	-.03
	%Maze words	**-.19***	-.03	-.07	.06	.04	.05	.04	.04	.04	-.01	-.02	.03	-.01	-.03	.10
	NDW	-.06	.01	-.02	-.06	.05	.02	-.14	-.06	-.06	**-.17***	-.04	-.05	-.100	.14	-.11
Micro-structural	Total referential ties	-.03	.02	.01	-.08	.06	.02	-.11	-.03	.02	-.12	.04	-.02	-.06	.13	**-.18***
	Cohesive adequacy (%)	**.19***	.05	-.03	-.06	.07	.04	**-.23***	-.10	-.06	-.13	-.09	-.05	-.08	.13	-.10
Macro-structural	% CIUs	-.01	-.01	-.01	-.14	-.05	-.09	.03	.03	.01	.07	.02	.02	.08	-.09	-.06
	CIUs per minute	.02	.10	.08	-.03	.09	.06	-.06	-.05	-.04	-.11	-.05	-.12	-.09	.06	-.02
	Local coherence	-.02	-.06	-.05	.04	.03	.04	-.02	-.02	-.04	-.05	-.07	-.08	-.03	-.06	-.02
	Global coherence	-.06	.01	-.02	-.10	-.05	-.07	.05	**.17***	.11	**.22***	.07	.08	**.17***	.02	.02
Super-structural	Schema deviation	.03	.06	.06	.14	.13	.15	-.07	.08	.03	**-.19***	-.14	-.13	-.13	.09	-.11
	Genre shift	.02	-.04	-.02	-.06	.01	-.02	-.10	-.13	-.03	**-.18***	.01	0	-.02	.03	-.02
	Order deviation	-.09	-.07	-.09	.02	.01	.02	-.02	-.03	-.05	**.14**	-.02	0	0	.04	-.085
	Restatement of Question	.11	.04	.07	-.03	.11	.08	-.10	**.18***	.06	-.08	.06	-.01	-.06	-.02	-.13

Note: Bolded values are significant at *$p<.05$ ** $p<.001$. 1 = PedsQL SR Physical 2 = PedsQL SR Psychosocial 3 = PedsQL SR Total; 4 = PedsQL PR Physical 5 = PedsQL PR Psychosocial; 6= PedsQL PR Total; 7= MFAD Problem solving; 8= MFAD Communication; 9= MFAD Roles; 10 = MFAD Affective Responsiveness; 11 = MFAD Affective Involvement; 12 = MFAD Behaviour Control; 13 = MFAD General Functioning; 14 = CASP Total 15 = La Trobe Communication Questionnaire

Dimension Reduction

A series of multiple regression analyses were planned in order to further examine relationships between cognition and spoken discourse, and between spoken discourse and psychosocial health. Given the sample size, this study was not powered to explore relationships between individual variables. As the primary purpose of this analysis was to facilitate multivariate analyses, Principal Component Analysis (PCA) was used to reduce variables to their underlying factors. Missing case analysis identified three participants for whom data on parent- and self-rated psychosocial health was missing. These cases were removed from this analysis. Super-structural discourse measures were removed from the PCA. These measures are exploratory in nature and were newly developed for the CUDP-A. To facilitate interpretation of this research in light of existing evidence, only micro-linguistic, micro-structural, and macro-structural measures were analysed.

All included measures correlated with at least one other measure at $r>.30$ within their respective domains, indicating reasonable factorability (see Supplementary material; Tabachnik & Fidell, 2007). The Kaiser-Meyer-Olkin measures of sampling adequacy were examined relative to the recommended threshold of >.70 (Kaiser, 1974) and Bartlett's tests of sphericity are reported (Tabacknik & Fidell, 2007). All communalities were compared to the threshold >.30 to confirm each item shared common variance with other items. If these criteria were satisfied, the data were deemed suitable for PCA. Given the exploratory nature of the research, only variables with loadings >.30 were interpreted in the analysis (Comrey & Lee, 1992). Components were determined via examination of the Eigenvalues >1.00 and scree plots generated from the PCA. All solutions were tested using orthogonal (varimax) rotations (Tabachnik & Fidell, 2007).

Discourse variables. The factorability of the 12 discourse variables (excluding super-structural measures) was examined. Sampling adequacy was supported by a Kaiser-Meyer-Olkin value of .666, and Bartlett's test of sphericity was significant, $\chi 2$ (66) = 1519.924, $p<.001$ (Tabachnik & Fidell, 2007). Inspection of Eigenvalues >1.000 and the scree plot indicated a four-factor solution (see Table 6.4). Factor One ($\lambda = 4.145$) accounted for 35% of total variance. Factor One contained measures sensitive to amount of output: total NDW, total utterances, total referential ties, total mazes, and cohesive adequacy and was therefore labelled 'Discourse Quantity'.

The second factor ($\lambda = 2.680$) accounted for 22% of total variance. Factor Two contained high loadings of percentage maze words and percentage CIUs, which measure word-level informativeness and relevance. As a result, this Factor was labelled '*Word-level Inaccuracy*'. Percentage CIUs was transposed to reflect inaccuracy. This variable also cross-loaded across Factors Two and Three. As above, the cross-loading onto Factor Three (italicised) was ignored as the discrepancy in factor loading was greater than .30 (Tabachnik & Fidell, 2007). The third factor (λ = 1.349) accounted for 11% of the variance and was labelled '*Utterance-level Quality*' due to the high loadings of local coherence, global coherence, and CIUs per minute. Finally, the fourth factor ($\lambda = 1.111$) accounted for 9% of total variance and was labelled '*Syntactic Complexity*' due to the high loadings of MLUw and Clausal Density. Two items, Total Mazes and %CIU, had cross-loadings >.30, however, these items had a strong primary-loadings of .77 and .79, respectively, and were therefore deemed to load onto their strongest factor (Matsunaga, 2010). Together, these four components accounted for 77% of the total variance in discourse measures.

Cognitive variables. For the cognitive variables, the Kaiser-Meyer-Olkin measure of sampling adequacy was .590 and Bartlett's test of sphericity was also significant, $\chi2\ (28) = 124.446$, $p<.001$. The PCA yielded an initial three-factor model with Eigen values >1.000, accounting for 26%, 15%, and 13% of the variance. Inspection of the factor loadings and scree plot, indicated solutions for a three and two-factor model using oblimin and varimax rotation. To enhance interpretation, the two-factor model that accounted for 41% of the variance was used in subsequent analysis. This model was preferred as it retained all cognitive items (all working memory variables would be removed due to cross-loadings) and was theoretically consistent with the categorisation of cognitive assessments as those of executive function and memory (see Table 6.5; Tabachnik & Fidell, 2007).

The three-factor solution has been provided in Appendix I.3. In the two-factor solution, Factor One ($\lambda = 2.041$) accounted for 26% of the variance. This Factor contained high loadings of the RAVLT Immediate and Delayed Memory tasks and was therefore labelled '*Verbal Memory*'. Factor Two ($\lambda = 1.202$) accounted for 15% of the variance. Factor Two contained high loadings of the N-back test (updating), CELF-4 Number Repetition (working memory capacity), Tower Test (planning), BRIEF-2 Screener (daily executive function), Stop-signal Task (inhibition), and the Trail-making Test (shifting). This Factor was therefore labelled '*Executive Function*'.

Table 6.4

Factor matrix for discourse PCA with Varimax rotation

	Factor			
Discourse measure	Discourse Quantity	Word-level Inaccuracy	Utterance-level Quality	Syntactic Complexity
NDW	.967			
C-units	.954			
Total referential ties	.931			
Total mazes	.774	*.550*		
Cohesive adequacy	.663			
%Maze words		.961		
%CIU		.791	-*.436*	
Local coherence			.835	
Global coherence			.684	
CIUpm			.589	
Clausal density				.888
MLUw				.825

Note: NDW = number of different words; c-units = total communication units; CIU = correct information unit; MLUw = mean length of utterance (words)

Table 6.5

Factor matrix for cognitive PCA with Varimax rotation

	Factor	
Task	Verbal Memory	Executive Function
RAVLT Delayed	.901	
RAVLT Immediate	.865	
N-back Task		-.715
CELF-4 Number Repetition		-.560
D-KEFS Tower Task		.536
BRIEF-2 Parent Screen		.449
Stop-signal Task		.376
D-KEFS Trail-making Test		.300

Psychosocial variables. The Kaiser-Meyer-Olkin measure of sampling adequacy for the psychosocial variables was .64, and the Bartlett's test of sphericity was significant, χ^2 (72) = 1382.376, $p<.001$. The PCA yielded a three-factor model with Eigenvalues >1.000 that accounted for 32%, 18%, and 12%, of the variance respectively (see Table 6). This model accounted for 62% of variance in psychosocial health. Factor One ($\lambda = 4.753$) accounted for 32% of the variance and contained high loadings of all the MFAD subscale (see Table 6.6, below). Factor One was therefore labelled ‘Family Functioning’. Factor Two (λ = 2.629) accounted for 18% of total variance and contained high loadings of all PedsQL Parent-report summary scores and the CASP. Factor Two was labelled ‘Parent-rated Psychosocial Health’. Factor Three (λ = 1.731) accounted for 12% of variance and contained high loadings of all three PedsQL Self-report summary scores and the self-rated LCQ Total Score. Factor Three was labelled ‘Self-rated Psychosocial Health’.

Table 6.6
Factor matrix psychosocial PCA with Varimax rotation

		Factor		
Task	Score	Family	Parent PSH	Self PSH
MFAD	General Functioning	.860		
	Problem-solving	.758		
	Affective Responsiveness	.748		
	Behaviour Control	.693		
	Affective Involvement	.670		
	Roles	.641		
	Communication	.562		
PedsQL Parent-report	Total Health		.973	
	Psychosocial Health		.896	
	Physical Health		.766	
CASP	Total score		.425	
PedsQL Self-report	Total Health			.973
	Psychosocial Health			.906
	Physical Health			.843
LCQ	Total score			-.401

Note: Family = Family Functioning; Parent PSH = Parent-rated psychosocial health; Self PSH = Self-rated psychosocial health.

Correlations between Factors

A series of bivariate correlations were run to determine the relationship between cognitive, discourse, and psychosocial factors, as well as age, gender, and oral language. The results are provided in Table 6.7, below.

Regression

A series of hierarchical regression analyses were conducted to test whether cognition and oral language were uniquely associated with discourse skills, and whether cognition, oral language, and discourse were uniquely associated with psychosocial health. First, the relevant assumptions of multiple linear regression were tested. A sample size of N=160 was adequate for a model containing five predictor variables (i.e. the most complicated model in this study; Tabachnick &

Fidell, 2007). Two Factors (Verbal Memory and Parent-rated Psychosocial Health) were non-normally distributed, however multiple regression analyses at N=160 are robust to deviations from normality (Tabachnik & Fidell, 2007). Examination of z scores indicated no presence of univariate outliers across all factors. Mahalanobis distances did not exceed the critical χ^2 for df = 2 of 13.82 for any cases in the data file indicating no presence of multivariate outliers (Tabachnik & Fidell, 2007). Finally, the assumption of multicollinearity was met as collinearity statistics (i.e. Tolerance and VIF) and were within accepted limits (Coakes, 2005; Menard, 2002).

Predicting discourse factors. Four hierarchical multiple regression analyses were conducted. One analysis was conducted for each discourse factor (Discourse Quantity, Word-level Inaccuracy, Utterance-level Quality, and Syntactic Complexity). Both cognitive factors (Verbal Memory and Executive Function) were entered at stage one of the regression analysis. This examined the proportion of variance in discourse accounted for by each cognitive variable independently. The oral language variable, CELF-4 CLS, was entered at stage two. At stage three, the interaction terms between CELF-4 CLS and the two cognitive factors (Verbal Memory and Executive Function) were entered. As the model contains interaction terms, analyses were conducted on standardised variables in an effort to reduce multicollinearity (Tabachnik & Fidell, 2007). Unstandardized and Standardised regression coefficients and squared semi-partial correlations (sr2) for each predictor in the regression models are reported in Table 6.8.

Discourse quantity. At stage one, Declarative Memory and Executive Function contributed significantly to the regression model $F(2, 155) = 9.772$, $p < .001$, and accounted for 11.2% of the variation in Discourse Quantity. Both Memory and Executive Function, p=.015, were significant predictors. Introducing CELF-4 CLS explained an additional significant 3% of variation in Discourse Quantity a, $F(1, 154) = 5.309$, p=.023. At stage two, Verbal Memory, p=.009, and CELF-4 CLS, p=.023, were significant predictors, while Executive Function became non-significant, p=.083. At stage three, addition of the two interaction terms explained an additional .8% of variation in Discourse Quantity, which was non-significant, $F(2, 152) = .773$, p=.463.

Table 6.7

Mean (standard deviation) factor scores and correlations with age and gender.

	Female (*n*=88)	Male (*n*=72)	1	2	3	4	5	6	7	8	9	10	11	12
1. Oral language	118.88 (9.43)	116.29 (11.33)												
Cognitive														
2. Verbal Memory	.117 (.951)	-.163 (1.09)	.348**											
3. Executive Function	-.223 (.944)	-.277 (1.014)*	-.264**	.000										
Discourse														
4. Discourse Quant.	.091 (1.01)	-.059 (1.016)	.304**	.278**	-.187*									
5. Word-level Inaccuracy	-.027 (.968)	-.034 (.996)	-.179*	-.083	-.041	.000								
6. Utterance-level Quality	.238 (.892)	-.334 (1.105)*	.116	.019	-.030	.000	.000							
7. Syntactic Complexity	.138 (1.07)	-.191 (.927)	-.159*	.061	-.103	.000	.000	.000						
Psychosocial														
8. Family Function	.053 (.00)	-.059 (1.01)	-.189*	-.067	.98	-.145	-.028	.015	.095					
9. P-R Psychosocial	.087 (.921)	-.099 (1.03)	.124	.004	-.113	.038	.059	.044	-.165*	.000				
10. S-R Psychosocial	-.125 (.934)	.193 (1.06)	-.008	-.044	-.025	.016	-.154	-.036	-.008	.000	.000			
11. Age	14.00 (1.22)	13.83 (1.03)	.058	.077	-.236**	.037	.105	.00	.100	-.008	-.142	.096		
12. Gender	-	-	-.124	-.125	.263**	-.084	.025	-.258**	-.137	-.056	-.122	.127	-.111	

Note: S-R Psychosocial = self-rated psychosocial health; P-R Psychosocial = parent-rated psychosocial health. Bolded values are significant at ** $p < .01$ * $p < .05$. Correlations within constructs are $r = .000$ due to use of orthogonal rotation, which assumes no correlations among variables.

Table 6.8

Unstandardized and Standardised coefficients and squared part correlations (sr2) for factors in regression predicting discourse factors

	Discourse quantity			Word-level inaccuracy			Utterance-level quality			Syntactic complexity		
Factor	*B*	β	*sr*²	*B*	β	*sr*²	*B*	β	*sr*²	*B*	β	*sr*²
Step 1												
Memory	.28	**.28****	.08	-.08	-.08	.01	.02	.02	.00	.06	.06	.00
EF	-.19	-.19	.04	-.04	-.04	.00	-.03	-.03	.00	-.10	-.10	.01
Step 2												
Memory	.21	**.21****	.04	-.01	-.01	.00	-.02	-.02	.00	.02	.02	.00
EF	-.14	**-.14**	.02	-.09	-.09	.01	.00	.00	.00	-.06	-.06	.00
CELF-4	.19	**.18***	.30	-.02	**-.19***	.03	.01	.12	.01	.01	.14	.02
Step 3												
Memory	.21	**.21***	.04	-.02	-.02	.00	-.03	-.03	.00	.01	.01	.00
EF	-.14	-.14	.02	-.09	-.09	.01	.00	.00	.00	-.06	-.06	.00
CELF-4	.21	**.21***	.03	-.21	-.21	.04	.11	.11	.01	.11	.11	.01
CELF4 *Memory	.02	.02	.00	-.07	-.07	.01	-.08	-.08	.01	-.12	-.13	.02
CELF-4*EF	-.09	-.09	.01	.10	.10	.01	.02	.02	.00	.14	.15	.02

Note. Bolded values are significant at **p*<.05, ** *p*<.001; EF = executive function.

Word-level inaccuracy. At stage one, Verbal Memory and Executive Function did not contribute significantly to the regression model F(2, 155) = .608, p=.546, and accounted for .8% of the variation in Word-level Inaccuracy. At stage two, the addition of CELF-4 CLS explained an additional 4% of variation in Word-level Inaccuracy, which was a significant change in R^2, F(1, 154) = 4.717, p=.031. At stage three, the addition of the two interaction terms explained an additional 1.6% of variation in Word-level Inaccuracy, which was non-significant, F(2, 152) = 1.264, p=.285.

Utterance-level quality. At stage one, Verbal Memory and Executive Function did not contribute significantly to the regression model F(2, 155) = .096, p=.909, and accounted for .1% of the variation in Utterance-level Quality. At stage two, the addition of the CELF-4 CLS explained an additional 1.3% of variation, which was a non-significant change in R^2, F(1, 154) = 1.818, p=.179. At stage three, addition of the two interaction terms to the regression model explained an additional .7% of variation in F(2, 155) = .096, p=.909, which was non-significant, F(2, 152) = .509, p=.602.

Syntactic complexity. At stage one, Declarative Memory and Executive Function did not contribute significantly to the regression model, F(2, 155) = 1.054, p=.351, and accounted for 1% of variation in Syntactic Complexity. At stage two, addition of the CELF-4 CLS explained 3% of variation in Syntactic Complexity, though this change in R2 was non-significant, F(1, 154) = 2.589, p=.110. At stage three, the addition of the two interaction terms explained an additional 4.1%, which was a significant change in R2, F(2, 152) = 3.395, p=.036. With all five predictors, the model explained 8% of variation in Syntactic Complexity. Crossover interactions between CELF-4*Verbal Memory, p=.078 and CELF-4*Executive Function, p=.059 approached significance; uniquely explaining 2% and 3% of variation, respectively.

Predicting psychosocial factors. Three hierarchical multiple regression analyses were conducted to estimate the proportion of variance in psychosocial health explained for by the four discourse factors. One hierarchical regression analysis was conducted for each psychosocial factor (Family Function, Parent-rated Psychosocial Health, and Self-rated Psychosocial Health). At stage one, both cognitive factors and CELF-4 CLS were entered to control for underlying language skills, Executive Function, and Memory.

At stage two, the discourse factors were entered into the model. Due to non-significant results of previous analyses, the interaction terms were not entered into the model. As a result, analyses were run on unstandardized variables. Unstandardized and Standardised regression coefficients and squared semi-partial correlations (sr^2) for each predictor in the regression models are reported in Table 6.9 below.

Parent-reported family functioning. At stage one, oral language skills, Verbal Memory, and Executive Function did not contribute significantly to the model F(3, 151) = 2.105, p=.102, and accounted for 4% of variation in Family Functioning.

Table 6.9

Unstandardized and Standardised regression coefficients and sr2 for factors in predicting psychosocial health factors.

	Family Functioning			Parent-PSH			Self-PSH		
Factor	*B*	β	*sr*2	*B*	β	*sr*2	*B*	β	*sr*2
Stage 1									
CELF-4 CLS	-.02	**-.18***	.03	.01	.11	.01	.00	-.01	.00
Dec. Memory	.00	.00	.00	-.03	-.03	.00	-.04	-.04	.00
Ex. Function	.05	.05	.00	-.08	-.09	.01	-.03	-.03	.00
Stage 2									
CELF-4 CLS	-.02	**-.21***	.03	.01	.15	.02	.00	-.05	.00
Dec. Memory	.01	.01	.00	-.03	-.03	.00	-.05	-.05	.00
Ex. Function	.04	.04	.00	-.09	-.09	.01	-.04	-.04	.00
Disc. Quantity	-.08	-.08	.01	-.02	-.02	.00	.04	.04	.00
W-L Inaccuracy	-.08	-.08	.01	.10	-.09	.01	-.16	**-.16***	.03
U-L Quality	.05	.05	.00	.02	.02	.00	-.03	-.03	.00
Syntactic Complexity	.14	.09	.02	-.17	**-.17***	.03	.01	.01	.00

Note. Bolded values are significant at *$p<.05$

Despite a non-significant regression model, CELF-4 was a significant predictor, p=.045. At stage two, addition of the discourse factors explained an additional 3.4% of variation in Family Functioning, though this change in R^2 was non-significant $F(4, 147) = 1.352$, p=.254. Despite a non-significant regression model, CELF-4 CLS remained a significant predictor, p=.029, uniquely accounting for 3.1% of variance. Syntactic Complexity approached significance as a unique predictor, p=.07.

Parent-rated psychosocial health. At stage one, CELF4-CLS, Verbal Memory, and Executive Function did not contribute significantly to the model, $F(3, 151) = 1.113$, p=.346, and accounted for 2% of variation in Parent-rated Psychosocial Health. At stage two, addition of the discourse factors accounted for an additional 4% of variance, though this R^2 change was non-significant, $F(4, 147) = 1.449$, p=.221. Despite a nonsignificant regression model, Syntactic Complexity was a significant predictor of Parent-rated Psychosocial Health, p=.034, uniquely accounting for 3% of variance. No other predictors were significant.

Self-rated psychosocial health. At stage one, CELF-4 CLS, Verbal Memory, and Executive function did not contribute significantly to the model, $F(3, 151) = .134$, p=.939; accounting for only .3% of variance in Self-rated Psychosocial

Health. At stage two, the addition of discourse factors explained an additional 2.5% of variation. This change in R2 was non-significant, $F(4, 147) = 1.010$, $p=.404$. Despite a non-significant regression model, Word-level Inaccuracy was a significant predictor of Self-rated Psychosocial Health, $p=.049$. No other predictors were significant.

Discussion

Currently, we have a limited understanding of the cognitive and psychosocial factors associated with spoken discourse skills of adolescents within non-clinical populations. This is a critical gap for researchers and clinicians in the area of adolescent brain injury as current recommendations encourage a biopsychosocial approach to practice; considering the nature of, and relationships between, deficits in communication, cognition, and psychosocial domains (Morgan et al., 2017; Turkstra et al., 2015). By exploring how these factors are associated in adolescents without ABI, we aim to increase our understanding of the cognitive skills and psychosocial outcomes that may be related to disordered discourse in adolescents brain injury (Whyte, 2014). To address this, this chapter presented an exploratory study of the cognitive and psychosocial correlates of adolescent discourse data described in Chapter 4. The hypotheses for this study were partially supported. The results provided preliminary evidence of a relationship between cognition and discourse, and between discourse and psychosocial health in this sample.

Variability Across Domains of Assessment

Participants' performance on the CUDP-A and standardised assessment of oral language have been previously discussed in this thesis. To avoid repetition, the reader is directed to Chapter 4 (Study 3), with attention drawn to the stability of macro-structural and super-structural discourse measures in the adolescent reference sample set out earlier (indicated in low coefficients of variation indicating low variability across the sample). In contrast, micro-linguistic and micro-structural measures demonstrated moderate to high levels of variability indicating moderate and high coefficients of variation indicating high levels of variability. Few age-related differences were observed for oral language and spoken discourse skills.

Participants demonstrated considerable variability in performance on most measures of executive function. Adolescence is generally regarded as a transition period during which adolescents develop the functional relationship between cognitive functions and their application in everyday tasks (Luna & Sweeney, 2004). As such, the results are consistent with reports of instability in performance on cognitive tasks as this relationship becomes consolidated into adulthood (MacPherson, Gillebert, Robinson, & Vallesi, 2019). Despite variability across the sample, the paucity of age-related differences was consistent with studies that have documented maturation of inhibitory control (Anderson, Anderson, Northam, Jacobs, & Catroppa, 2001), cognitive flexibility (Huizinga, Dolan, & van der Molen, 2006), working memory capacity (Anderson, Anderson, et al., 2001; Conklin, Luciana, Hooper, & Yarger, 2007), updating (Loosli, Rahm, Unterrainer, Weiller, & Kaller, 2014), higher-level planning skills (Anderson et al., 2001), and verbal memory by early adolescence (Dickson et al., 2018). In contrast, the observation of age-related differences in ratings of daily executive behaviours is congruent with past literature (Huizinga & Smidts, 2010), suggesting that our participants also demonstrate potential ongoing maturation in the ability to *apply* discrete cognitive functions to real-world executive tasks as opposed to the discrete executive and memory processes themselves (Anderson, Anderson, et al., 2001; O'Hearn, Asato, Ordaz, & Luna, 2008).

Low to moderate variability was observed in measures of quality of life and daily participation (most coefficients of variation <15%) (Pimentel-Gomes, 1985) and family functioning (coefficients ≈ 30%). Some variability in performance was not unexpected given adolescence is generally associated with emotional and social instability and change; particularly between early to late adolescence (Brown, Patel, & Darmawan, 2017; Piaget, 1972). Similarly, the lack of age-related differences was not surprising as it is theorised that without significant issues related to mental or physical health, variability in HRQoL and psychosocial outcomes remains relatively stable throughout adolescence (Palacio-Vieira et al., 2008).

Relationships between Domains of Assessment

The core objective of this component of this program of research was to explore the cognitive and psychosocial factors associated with spoken discourse skills within the adolescent reference sample. In line with past literature in typically developing and clinical populations, performance on cognitive measures was related to performance on the CUDP-A. Similarly, the results provide very preliminary support for a relationship between discourse skills and psychosocial health.

Cognitive function and discourse. The results of this study were broadly consistent with literature that has established associations between executive function, verbal memory, and spoken discourse skills (Bramberg, 1987; Ylvisaker & Szekeres, 1989). First, at the univariate level, greater working memory capacity and better skills in updating in working memory were associated with better performance across micro-linguistic (productivity and lexical diversity), micro-structural (cohesive frequency), macro-structural (coherence), and super-structural features (adherence to discourse schema). Second, better planning skills were associated with better performance across micro-linguistic (fluency, morpho-syntactic complexity, and lexical diversity), micro-structural (cohesive adequacy) and macro-structural (efficiency of information transfer) features. Finally, the results support a link between better skills in encoding and recall of verbal information and micro-linguistic (productivity, fluency, and lexical diversity) and micro-structural discourse features (cohesive frequency and cohesive adequacy).

While the roles of these cognitive skills in discourse have received little attention in the literature, particularly in adolescence (Slevc, 2011), the findings are consistent with their link to oral language skills observed in studies of younger children (Hickmann, 1980; Leclercq & Majerus, 2010; Majerus, Poncelet, Greffe, & Van der Linden, 2006). The results are also consistent with the systematic review (see Chapter 2), where multiple correlations between discourse deficits and impairments in planning, working memory, and verbal memory were observed in speakers with ABI (Coelho et al., 2012; 2013; Galetto et al., 2013; Hay & Moran, 2005 Marini et al., 2014; 2017). These relationships observed within the reference sample are also somewhat analogous to those in Gernsbacher's SBF (1990), suggesting that, for adolescents without ABI, executive function and verbal memory skills may have a role in the ability to retrieve, maintain, and update discourse frameworks and individual utterances; this may facilitate sequencing of content and maintain coherence, length, and complexity, including the use of appropriate referential ties Gernsbacher, 1990). Given the prevalence of co-occurring discourse and cognitive deficits in paediatric ABI (Chapman et al., 2006), and other populations such as DLD (Delage & Frauenfelder, 2019; Leonard, 1998), the links between these impairments should remain a focus for future research.

The paucity of significant results linking discourse to other executive functions such as inhibition and shifting was not consistent with the results of the systematic review that documented their association with discourse deficits post-ABI, and role documented in Gernsbacher's (1990) SBF. This observation was, however, consistent with past literature in non-clinical adolescent populations, which has previously been attributed to task-related factors (Kuijper, Hartman, Bogaerds-Hazenberg, & Hendriks, 2017). For instance, The Stop-signal Task (Verbruggen et al., 2019) measures inhibition of motor and not verbal responses. Failure to detect a relationship between inhibition and discourse may reflect the involvement of a different form of suppression mechanism. This may be better assessed using tasks directed at cognitive and not motor inhibition (Kujiper et al., 2017). This is supported by studies that have documented relationships between language measures and cognitive but not motor inhibition(Shao, Janse, Visser, & Meyer, 2014). Similarly, a measure of shifting that involves verbal information may be more suited to exploring the relationship between executive functions and discourse skills (de Paula, Chequer de Castro Paiva, & Costa, 2015). The inclusion of cognitive tasks that manipulate verbal information is an important consideration for future research into discourse-level language skills.

Given the exploratory nature of this research, the relationship between cognitive function and discourse was also explored at the multivariate level. Relative to the findings of univariate analyses, multivariate results illustrated a more ambiguous relationship between cognition and discourse. In this study, better oral language skills were uniquely related to processes underlying the quantity and word-level inaccuracy of discourse output. This is consistent with the correlations between oral language and discourse described in Chapter 4 (see Appendix G.2) and supports proposed stages of discourse processing that involve the retrieval and application of word and sentence-level language skills during morphophonological, lexical, and syntactic encoding (Frederiksen & Stemmer, 1993). Contrary to the hypotheses, however, multivariate testing provided limited evidence of a unique contribution of cognitive function to discourse in this sample. Verbal memory was a significant unique contributor to the processes underlying discourse quantity in this sample. This suggests that better skills in the retention of verbal information are related to the ability to produce longer discourse samples, which provide more opportunity to demonstrate language skills, (i.e. those features represented by the Discourse Quantity factor).

Overall, results were generally consistent with past literature, including those relationships documented in the systematic review in speakers with ABI. They also provide support for the theoretical relationships between cognitive and communication domains described in Gensbacher's (1990) SBF and MacDonald's (2017) model of cognitive communication. The finding of multiple relationships at the univariate level and few at the multivariate level suggests the potential presence of shared variance among discourse and cognitive measures. This direction is supported by the observation that the outcome of dimension reduction for discourse skills did not reflect the theoretical categorisation by Coelho (2007). The potential for shared variance highlights two key avenues for future research. First, studies with adequate power should examine the relationship between specific discourse and cognitive variables without undertaking dimension reduction. Alternatively, exploring the processes underlying the discourse and cognitive skills assessed in this study is an important direction for future research. This is particularly important given the variability in discourse and cognitive measures present in the wider literature on discourse and cognition as described in the systematic review (Coelho, 2007; Hill et al., 2018). Further examination of shared variance in discourse and cognitive measures may contribute to a more unified understanding of the correlates of discourse skills.

Psychosocial health and discourse. This study also sought to explore the psychosocial factors associated with discourse skills within the adolescent reference sample. Consistent with hypotheses, evidence of relationships between HRQoL, participation, family function and spoken discourse was observed at the univariate level. In this study, ratings of physical HRQoL were related to micro-linguistic (dysfluency and syntactic complexity) and micro-structural discourse features (cohesive adequacy), and total HRQoL was related at the micro-linguistic features (morpho-syntactic complexity). The relationship between discourse and physical HRQoL, specifically, was not expected, yet it is consistent with documented links between physical motor skills and social wellbeing in children with language and communication deficits (Feeney, Desha, Khan, & Ziviani, 2017), particularly the protective nature of good physical wellbeing for HRQoL in clinical populations (Feeney, Desha, Ziviani, & Nicholson, 2011). Evidence of a link between spoken discourse skills and family function is consistent with the proposed association between unsuccessful communication and problematic family interaction (Epstein et al., 1983). This is also congruent with associations between language, social skills and family outcomes in adolescents with DLD (Ozyurt & Dinsever, 2017), and those within the youth justice system (Matlack, McGreevy, Rouse, Flatter, & Marcus, 1994). Despite this, given the number and size of correlations observed between CUDP-A measures and performance on the MFAD (Epstein et al., 1983), further research should seek to draw firmer conclusions as to the link between these domains in adolescence.

The lack of significant correlations between spoken discourse and psychosocial HRQoL, daily participation, and perceived communication competence was unexpected, given these measures comprised items relating to social interaction, family function, and emotional wellbeing (Bedell, 2004; Douglas, 2010; Varni et al., 2001). Furthermore, spoken communication skills are generally regarded as important drivers of quality interaction and participation in the home, school, and the community (Fonzi, Schneider, Tani, & Tomada, 1997; Turkstra, 2000). These findings are, however, consistent with past literature that has documented no association between psychosocial and language-based variables for typically developing adolescents due to proposed limited variability and high ratings of psychosocial wellbeing in non-clinical populations (Durkin & Conti-Ramsden, 2007). Indeed, adolescents without immediate threat to mental or physical wellbeing have tended to perform at ceiling on standardised measures of psychosocial health designed for clinical populations, which was also the case in this study (Palacio-Vieira et al., 2008). This highlights avenues for future research into the psychosocial correlates of discourse skills. First, studies may benefit from using more nuanced measures of psychosocial wellbeing that may detect variability in non-clinical populations. Further, variability may be achieved by recruiting larger, more diverse samples including clinical populations who are at risk of reduced discourse and psychosocial outcomes. This is supported by reports of poor emotional and social wellbeing in related to language and communication deficits (Lewis et al., 2016; Lyons & Roulstone, 2018; Markham, Laar, Gibbard, & Dean, 2008).

The results of multivariate analyses did not provide consistent evidence of a unique contribution of spoken discourse skills to psychosocial health in this sample. The processes underlying sentence complexity contributed uniquely to parent-rated psychosocial health, and those underlying word-level inaccuracy in discourse uniquely predicted self-rated psychosocial health. Oral language was also revealed as an independent predictor of family function. While these results are generally consistent with the theorised link between competent oral language skills and wellbeing in adolescence (Turkstra, 2000), the presence of few significant findings and small effect sizes prevents stronger conclusions as to the relationship between discourse and psychosocial outcomes in this sample. Overall, the results provide some preliminary support for a relationship between spoken discourse skills and psychosocial health at the univariate level. This is consistent with the view that discourse skills are important for psychosocial wellbeing (Turkstra, 2000), and supports the link between communication and psychosocial domains depicted in MacDonald's (2017) model of cognitive-communication.

Clinical and Theoretical Implications

This study provides a unique contribution to our understanding of the cognitive and psychosocial factors associated with spoken discourse skills within a sample of adolescents that represent a mainstream classroom. The results of this study have both theoretical and clinical implications for our knowledge of discourse production within clinical and non-clinical populations. First, these results provide promising support for the relationship between cognition and discourse production illustrated in Gernsbacher's (1990) SBF. The use of this model in understanding the stages of discourse production within an adolescent cohort is supported, as well as the continued application of this model within empirical studies of the cognitive correlates of discourse in clinical and non-clinical populations. By exploring the cognitive factors related to discourse skills in this sample, this study adds to our knowledge of the potential cognitive correlates of poor discourse within clinical population such as those with ABI. Further, the potential to contribute to our knowledge of treatment theories for discourse-based interventions is present, specifically with regards to the nature of discourse production and its relationship with cognitive function at this age.

This study is also unique in its exploration of the psychosocial factors associated with spoken discourse skills within a mainstream adolescent cohort. Although the results revealed an ambiguous relationship between discourse and psychosocial health, the findings provide some preliminary support of the link between spoken discourse and positive performance on psychosocial measures of quality of life, family function, perceived communication competence, and daily participation in adolescents without ABI. The results support the connection between communication and psychosocial domains as is described by the ICF-CY (WHO, 2001), and by MacDonald's (2017) model of cognitive-communication. The findings also have implications for continued empirical investigation into psychosocial correlates of discourse that would benefit from recruiting larger, more diverse samples and using subjective psychosocial assessments more suitable to clinical and non-clinical samples. Finally, this study provides a preliminary contribution to enablement theory for discourse interventions within clinical populations. Specifically, evidence of a relationship between features of discourse across micro-linguistic to super-structural levels and psychosocial health may support the potential impact of discourse treatment on daily wellbeing. As such, the relationship between discourse and psychosocial health should be a key focus of future research.

Limitations and Future Directions

This study was powered to detect large effects, which would have reduced capacity to detect any small to moderate relationships between variables assessed. Future studies, with more adequate power, should examine the association between individual measures across these domains to obtain a more detailed, and specific, understanding of their functional relations. The lack of variability in participants' performance may also have limited the ability to detect relationships between variables. Further exploration of factors associated with discourse could also be explored within clinical populations who may be more inherently variable in their performance across areas of assessment. Equally, it may be fruitful to examine relationships between cognition and discourse through more complex discourse tasks in non-clinical populations, such as the use of dual-task paradigms. In a mainstream population who demonstrate little variability cognitive and discourse performance, implementing a dual-task paradigm in which discourse and cognitive tasks are completed simultaneously may be sufficiently demanding so as to induce sufficient variability to detect of relationships between domains (Hegarty, Shah, & Miyake, 2000). The use of this methodology within non-clinical populations is supported by Kemper et al (2010) who observed simultaneous completion of a pursuit rotor-task induced more fragmented, ungrammatical, and incoherent discourse (Kemper, Schmalzried, Hoffman, & Herman, 2010). Implementing a dual-task paradigm to explore the cognitive correlates of discourse skills in adolescence may be a salient direction for future research in clinical and non-clinical populations. The psychosocial assessments used in this study were selected due to their relevance and use in paediatric ABI (to facilitate future comparisons between adolescents with and without ABI). Despite this, they may not have been suitable for use within this adolescent reference sample. Future research would benefit from using more sensitive measurements suitable for non-clinical populations such as those that are not specific to health-related aspects of quality of life and wellbeing. Alternatively, it may be valuable for future studies to adopt a qualitative approach to exploring caregivers' and individuals' perspectives on potential relationships between communication skills and family wellbeing to explore associations in adolescents without ABI.

Chapter 5 documented significant effects of genre across all CUDP-A measures within this sample, which were discussed in light of potential variability in linguistic and cognitive demands across genres. The correlates of adolescent discourse may vary by genre, which is an important consideration for future research, given its implications for the selection of measurement context for discourse assessment and intervention in clinical populations. Future research may also examine the factors associated with interactive, dialogic discourse. Conversation may have greater relevance to psychosocial health given its role in daily social and academic interaction and place additional demands on cognition in order maintain pragmatic and contextual requirements of communication during adolescence (Byom & Turkstra, 2012). Finally, the results of dimension reduction for discourse variables was not expected, as they did not conform to the theoretical categorisation used in this study (Coelho, 2007). Given the number of discourse measures present in the literature, and the potential for shared variance among discourse variables (as discussed previously), further examination of the constructs underlying discourse-based language measures is warranted. This may inform assessment and the selection of treatment goals and targets related to specific discourse behaviours.

Conclusion

This study explored the cognitive and psychosocial factors associated with spoken discourse data obtained using the CUDP-A within the adolescent reference sample. The CUDP-A was able to elicit sufficient samples of spoken discourse to explore these associations across participants, supporting its use in future studies of adolescent discourse. Relationships between cognition and discourse were broadly consistent with past literature and the processes described in Gernsbacher's SBF (1990). At the univariate level, cognitive skills were related to features of spoken discourse across levels of analysis (i.e. micro-linguistic to super-structural features). These relationships were more ambiguous at the multivariate level suggesting potential shared variance in across cognitive and discourse measures. The findings also provided some preliminary evidence of a relationship between spoken discourse and psychosocial health in adolescents without ABI. This is consistent with the link between psychosocial and communication domains described within MacDonald's (2017) model, yet limited variability in discourse and psychosocial health measures prevented stronger conclusions.

An exploration of correlates of spoken discourse within clinical and non-clinical populations should remain a central focus of ongoing research, continuing to inform our understanding of deficits in clinical populations including paediatric ABI. Specifically, this would contribute to our knowledge of the mechanisms by which brain injury disrupts the functional relationship between cognition and discourse, and the potential impact of this on daily psychosocial outcomes (Whyte, 2014). Cognitive and psychosocial correlates of spoken discourse may be best explored in larger and/or more diverse samples, including clinical populations who are at risk of concomitant deficits in cognitive function, spoken discourse, and psychosocial health. This leads to the objective of the final empirical study of this thesis which is reported in Chapter 7. The final study aims to pilot the CUDP-A on two adolescents with a history of ABI in order to obtain detailed profiles of spoken discourse. Using single-case methodology, performance on the CUDP-A and the same measures of cognition and psychosocial health will be compared to the adolescent reference sample. Patterns in performance across domains of assessment (cognition, oral language, discourse, and psychosocial health) will be interpreted in light of the results of the study reported in this chapter, the broader literature, and theoretical frameworks to draw conclusions as to potential relationships between these areas in adolescents with a history of ABI.

Chapter 7

Cognition, Communication, and Psychosocial Health in Two Adolescents with ABI

Chapter Overview

MacDonald's (2017) model of cognitive communication (Figure 1) emphasises the need to consider discourse skills beyond the scope of a communication impairment alone. While this includes a detailed understanding of the nature of discourse skills in this population, it involves an acknowledgment of potential comorbid difficulties in cognitive function as well as potential activity limitations and participation restrictions that exist across different environments (MacDonald, 2017). This also requires an awareness of how these difficulties may be inter-related and the implications of these relationship for clinical practice (Morgan et al., 2017; WHO, 2007). Few studies, however, have examined the extent to which impairments in spoken discourse co-exist with deficits across cognitive and psychosocial domains in adolescents with ABI. This chapter presents the final empirical study of this thesis (Study 6). This study sets out to explore whether adolescents with a history of ABI perform significantly poorer than those without brain injury across cognitive, communication, and psychosocial domains of measurement. This last stage of this research program also presents the first pilot study of the CUDP-A (Hill et al., 2020) with adolescents with ABI.

The current study (Study 6) uses the CUDP-A to elicit samples of spoken discourse from adolescents with ABI and compare performance to the reference sample collected in Part Two of this research program. Study 6 aims to explore the presence of, and patterns in, concomitant deficits in spoken discourse, oral language, cognition, and psychosocial health in the participants with ABI in light of the results of previous chapters, external literature, and theoretical frameworks. Using Crawford and Howell (1998) modified *t* tests, the participants' performance on measures across cognitive, communication, and psychosocial domains are compared to the reference sample. The cases are also discussed in light of demographic and injury-related characteristics, which are often diluted in group-level designs (Margevičiūtė, 2012). Past studies have observed significant impairments in cognition (Babikian & Asarnow, 2009), communication (Turkstra et al., 2015), and psychosocial outcomes (Rosema, Crowe, & Anderson, 2012) in children and adolescents with a history of

ABI. Others have documented relationships between discourse and cognition (e.g. Brookshire et al., 2000; Hay & Moran, 2005), and discourse and psychosocial outcomes in paediatric ABI (Aguilar et al., 2019). Consequently, we predict participants with ABI to perform significantly poorer than the reference sample across all domains of assessment. Furthermore, we predict a particular pattern of impairment where poorer discourse skills are observed in the context of poorer cognitive and psychosocial outcomes.

Method

Recruitment of Participants With ABI

To be eligible for inclusion in this phase of the research program, adolescents were required to have a history of diagnosed traumatic or non-traumatic ABI, speak English as their first language, and no premorbid diagnosis of ASD or intellectual disability. An ABI was defined as any traumatic or non-traumatic injury to the brain occurring after birth (Cullen et al., 2008). Participants with injuries to areas specific to language processing were excluded so as to recruit participants with non-aphasic cognitive-communication deficits. There were no restrictions placed on the cause, severity, or chronicity of injury. Participants were also required to have adequate visual, physical, and auditory acuity in order to participate in assessments involving spoken communication and the physical and/or visual manipulation of test items. Participants could have a history of Speech Pathology intervention prior to their ABI, providing the aforementioned criteria were met.

Perth-based disability service providers relevant to paediatric ABI were contacted regarding their potential to assist with recruitment by disseminating the project's promotional material (Appendix J.1) via their online or print media to clients and caregivers. Professional contacts of members of the research team were approached to assist with recruitment by providing promotional material to colleagues and clients. The research was also advertised via Facebook and Twitter, and professional networks and groups relevant to Speech Pathology and ABI. Parents of adolescents with ABI who wished to take part in the study were invited to contact a member of the research team, after which they were provided with ethics approved information sheets and consent forms (see Appendix J.2). All participants were encouraged to discuss the research project with friends and family who may be eligible for involvement in the study.

Demographic Information

Two participants with ABI participated in this research. Demographic characteristics were consistent with those of the adolescent reference sample. Key information is reported in Table 7.1.

Table 7.1
Demographic characteristics of participants with ABI

Initial	Gender	Age: test (y;m)	Age: injury (y)	TPO (y)	Type	Location*	Severity*	Cause
DL	Male	12;5	6	~6	DIA	Diffuse	Mod-sev	MVA
HB	Male	14;2	12	~2	Stroke	R-hemi	Mod	MBA

Note: TPO = time post injury; DIA = diffuse axonal injury; MVA = motor vehicle; MBA = motorbike accident; accident. *as reported by parent

DL. DL was 12;5 at time of assessment. He is a right-handed male who sustained a severe ABI following a motor vehicle accident at six years of age, which resulted in diffuse damage to his cerebral cortex and brainstem. DL receives ongoing multidisciplinary intervention including physiotherapy, occupational therapy, and speech pathology. Parent-report indicates his current Speech Pathology goals cover intelligibility and social skills. He also receives ongoing academic support in and out of the classroom

HB. HB was 14;2 at time of assessment. He is also a right-handed male who sustained a severe ABI following a motorbike accident at age 12. Injuries related to his accident resulted in a right middle cerebral artery infarct due to carotid artery clot resulting in a loss of 75% of the right hemisphere. HB receives ongoing Speech Pathology intervention for vocal fold palsy and resultant reduced intelligibility. According to his parents, vocal fold paralysis has resulted in significantly reduced vocal intensity and reduced willingness to participate socially. HB has no history of Speech Pathology intervention for aphasia or language deficits, but receives specialist management for airway and voice, as well as outpatient physiotherapy and occupational therapy. He also receives ongoing psychological treatment for mental health issues and academic/learning support in and outside of the classroom.

Materials

Participants with ABI completed the same assessment battery as the adolescent reference sample described in Study 3 and Study 5. In an effort to avoid repetition please see pages 98 to 100 for a description of discourse and oral language assessments and pages 144 to 149 for a description of cognitive and psychosocial measures.

Statistical Analysis

Raw scores were calculated for each participant across the assessment tasks. Participants' raw scores were compared to the mean and standard deviation of the reference sample on the same assessment task (see Chapter 6) using a series of Crawford and Howell (1998) modified *t*-tests (software is available via http://www.homepages.abdn.ac.uk/j.crawford/pages/dept/SingleCaseMethodology.htmw). This test was selected as it compares each participant's raw scores with the reference sample to determine whether the participant falls within or outside the parameters of the adolescent reference sample (Crawford & Howell, 1998). Crawford and Howell (1998) *t*-tests also provide *z* scores as a measure of effect size.

Results

Participants' performance across domains of assessment and results of Crawford and Howell (1998) comparisons to the complete reference sample and age-matched subgroups are reported below. Tables summarising participants' performance across domains of assessment compared to age-matched reference sub-groups are reported in Appendix J.3 to J.6.

Spoken Discourse

DL. As predicted, Crawford and Howell (1998) analyses revealed significant differences between DL and the complete reference sample (Table 7.2 and Table 7.4) and 12-year-old age-matched peers (see Appendix J.3 and Appendix J.5) across micro-linguistic to super-structural variables. As evident in the tables, significant results were not consistent across genres, with DL demonstrating poorer performance in personal recount and persuasive discourse.

HB. HB's performance on the CUDP-A also differed significantly across micro-linguistic, macro-structural, and super-structural features from the complete reference sample (see Table 7.3 and Table 7.4) and the 14-year-old subgroup (see Appendix J.4 and Appendix J.5). No differences were observed in micro-structural measures when compared to the complete reference sample and age-matched peers. As with DL, significant analyses were not consistent across discourse genres. HB differed most frequently in personal recount, with no significant results in fictional narrative and only one in both persuasive and expository samples.

Oral Language

DL. DL obtained a CELF-4 CLS (93) above the clinical cut-off of 85, indicating language skills within the average range (Semel et al., 2003), see Table 7.5. His score did, however, fall significantly below that of the whole reference sample (p=.009) (see Table 33) and 12-year-old sub-group (p=.037) (see Appendix J.6); indicating poorer expressive and receptive language skills than the reference sample.

HB. HB obtained a CELF-4 CLS (103) above the clinical cut-off of 85, also indicating language skills within the average range (Semel et al., 2003). His score did not differ significantly from either the reference sample (see Table 7.5) or the 14-year-old subgroup (see Appendix J.6), indicating comparable general receptive and expressive oral language skills to reference sample.

Cognitive Function

DL. DL's demonstrated significant impairment on multiple cognitive assessments, see Table 7.5. Compared to the complete reference sample, DL performed significantly poorer on the CELF-4 Number Repetition (p=.038), N-back task (p=.040), Stop-signal Task (p=.028), Tower Test (p=.010), Trail-making Task (p=.010), BRIEF-2 screen, (p=.021), and the RAVLT Delayed (p=.027) (see Table 32). The same pattern of impairment was observed relative to the 12-year-old reference subgroup, with the exception of the CELF-4 Number Repetition, N-back, and Trail-making Test (see Appendix J.6).

HB. HB demonstrated significantly poorer performance on the Stop-signal Task (p=.035), and the Trail-making Test (p<.001), see Table 7.5. Compared to the 14-year-old reference subgroup, HB performed significantly poorer only on the Trail-making Test (p<.001), see Appendix J.6.

Table 7.2

DL performance on CUDP-A measures across genres and comparison to the reference sample (bolded values indicate significant comparisons).

	All			Recount			Exposition			Persuasive			Narrative		
Measure	Ref *M*(*SD*)	DL	*p*	Ref *M*(*SD*)	DL	*p*	Ref *M*(*SD*)	DL	*p*	Ref *M*(*SD*)	DL	*p*	Ref *M*(*SD*)	DL	*p*
Micro-linguistic															
C-units	124.9 (90.9)	59	.235	40.7 (40.5)	23	.332	21.7 (18.3)	10	.262	28.0 (22.0)	14	.263	34.3 (30.1)	11	.221
NDW	463.9 (221.9)	280	.205	125.1 (60.5)	99	.338	89.8 (53.4)	47	.213	114.4 (57.8)	80	.276	134.6 (71.5)	54	.131
Mazes	73.1 (68.7)	8	.276	21.2 (26.5)	1	.224	17.2 (17.5)	2	.194	20.0 (20.4)	2	.190	14.7 (20.3)	3	.283
%Maze words	9.9(4.2)	**2**	**.031**	9.3(4.6)	**1**	**.037**	13.5(6.8)	3	.062	10.6(5.3)	**1**	**.036**	6.4(4.8)	3	.239
MLUw	9.3(1.3)	8.3	.222	7.8(1.3)	7.8	.500	8.6(1.9)	6.3	.114	10.7(2.5)	10.3	.437	10.3(2.2)	8.6	.221
Clausal density	1.3(.1)	**1**	**.001**	1.1(.2)	1.1	.500	1.3(.3)	0.9	.093	1.6(.4)	1.1	.107	1.3(.2)	1.3	.500
Micro-structural															
Total ties	90.4 (68.8)	24	.169	25.3 (28.9)	7	.264	14.0 (3.9)	3	.216	19.9 (16.7)	5	.187	31.1 (25.7)	1	.122
Cohesive adequacy (%	68.0 (16.8)	53	.187	62.8 (24.7)	**14.3**	**.026**	63.2 (33.7)	100	.138	55.1 (27.8)	**0**	**.025**	91.0 (16.8)	100	.297
Macro-structural															
Local coherence	3.9 (.4)	**3.2**	**.041**	3.9(.4)	**2.2**	**<.001**	3.6(.8)	4.3	.192	3.8(.5)	**2.8**	**.024**	4.2(.5)	3.4	.056
Global coherence	4.4 (.3)	**3.6**	**.004**	4.3 (.4)	**3.6**	**.041**	4.2(.6)	**2.6**	**.004**	4.4(.5)	**3.4**	**.024**	4.8(.3)	4.7	.370
%CIU	80.9 (6.2)	77.3	.282	78.8 (7.8)	**64.5**	**.035**	78.7 (7.8)	76.9	.404	81.9 (7.9)	87	.260	85.5 (8.0)	80.5	.267
CIUpm	112.4 (23.0)	**47.2**	**.003**	105.8 (29.2)	**42**	**.015**	96.0 (28.1)	55.6	.077	122.6 (29.5)	**56.9**	**.014**	125.0 (33.2)	**34.3**	**.004**
Super-structural															
Schema deviation	9.2(5.3)	7	.341	2.6(2.3)	3	.436	3.4(1.8)	3	.413	2.1(1.7)	0	.114	1.1(2.3)	0	.313
Order deviation	.5(.8)	0	.269	.1(.3)	**1**	**.002**	.2(.5)	0	.317	.2(.5)	0	.372	.01(.1)	0	.450
Genre shift	.3(.7)	1	.144	-	0	n/a	.2(.7)	1	.142	.01(.2)	0	.475	-	0	n/a
RSQ	.04(.3)	0	.367	.1(.3)	0	.379	.1(.2)	0	.401	.01(.2)	0	.450	.01(.1)	0	n/a

Note: Comparisons were also performed with age-matched sub-groups (see Appendix J.3). '-' = code did not occur in reference sample.

Table 7.3

HB performance on CUDP-A measures across genres and comparison to the reference sample (bolded values indicate significant comparisons).

Measure	All			Recount			Exposition			Persuasive			Narrative		
	Ref *M*(*SD*)	HB	*p*	Ref *M*(*SD*)	HB	*p*	Ref *M*(*SD*)	HB	*p*	Ref *M*(*SD*)	HB	*p*	Ref *M*(*SD*)	HB	*p*
Micro-linguistic															
C-units	124.9 (90.9)	100	.392	40.7 (40.5)	66	.267	21.7 (18.3)	9	.245	28.0 (22.0)	20	.358	34.3 (30.1)	5	.167
NDW	463.9 (221.9)	360	.321	125.1 (60.5)	181	.179	89.8 (53.4)	62	.302	114.4 (57.8)	82	.288	134.6 (71.5)	35	.083
Mazes	73.1 (68.7)	**61**	**.007**	21.2 (26.5)	34	.315	17.2 (17.5)	10	.341	20.0 (20.4)	13	.366	14.7 (20.3)	4	.300
%Maze words	9.9(4.2)	**0.1**	**.011**	9.3(4.6)	11	.356	13.5(6.8)	12	.413	10.6(5.3)	14	.262	6.4(4.8)	7	.450
MLUw	9.3(1.3)	8.7	.323	7.8(1.3)	7	.270	8.6(1.9)	9.4	.337	10.7(2.5)	8.5	.191	10.3(2.2)	10	.446
Clausal density	1.3 (.1)	1.4	.160	1.1(.2)	1.2	.309	1.3(.3)	1.4	.370	1.6(.4)	1.8	.500	1.3(.2)	1.2	.309
Micro-structural															
Total ties	90.4 (68.8)	46	.260	25.3 (28.9)	31	.422	14.0 (3.9)	5	.259	19.9 (16.7)	8	.239	31.1 (25.7)	2	.130
Cohesive adequacy (%	68.0 (16.8)	72.2	.402	62.8 (24.7)	58.1	.425	63.2 (33.7)	80	.309	55.1 (27.8)	50	.427	91.0 (16.8)	100	.297
Macro-structural															
Local coherence	3.9(.4)	**3.2**	**.041**	3.9(.4)	**3.1**	**.024**	3.6(.8)	3	.227	3.8(.5)	3	.056	4.2(.5)	3.6	.116
Global coherence	4.4(.3)	**3.5**	**.002**	4.3(.4)	3.7	.068	4.2(.6)	**2.9**	**.016**	4.4(.5)	**3.3**	**.015**	4.8(.3)	5	.253
%CIU	80.9 (6.2)	80.7	.487	78.8 (7.8)	78.6	.489	78.7 (7.8)	86	.179	81.9 (7.9)	71.2	.089	85.5 (8.0)	85.7	.490
CIUpm	112.4 (23.0)	135.2	.162	105.8 (29.2)	121.2	.299	96.0 (28.1)	129	.122	122.6 (29.5)	117.7	.434	125.0 (33.2)	172.9	.076
Super-structural															
Schema deviation	9.2(5.3)	**19**	**.033**	2.6(2.3)	**9**	**.003**	3.4(1.8)	5	.184	2.1(1.7)	3	.284	1.1(2.3)	2	.348
Order deviation	.5(.8)	1	.260	.1(.3)	**1**	**.002**	.2(.5)	1	.055	.2(.5)	0	.372	.01(.1)	0	.450
Genre shift	.3(.7)	0	.361	-	0	n/a	.2(.7)	0	.338	.01(.2)	0	.475	-	0	n/a
RSQ	.04(.3)	**1**	**.019**	.1(.3)	**1**	**<.001**	.1(.2)	0	.401	.01(.2)	0	.450	.01(.1)	0	n/a

Note: Comparisons were also performed with age-matched sub-groups (see Appendix J.4). '-' = code did not occur in reference sample.

Table 7.4

Participant performance on genre-specific super-structure -A measures comparison to the reference sample (bolded values indicate significant comparisons).

		Participant			
Schema component	Ref *M*(*SD*)	DL	*p*	HB	*p*
Recount					
Orientation to character	2.5(.77)	**0**	**<.001**	3	.298
Orientation to location	1.4(.7)	**0**	**.028**	**0**	**.028**
Orientation to time	1.4(.9)	0	.071	2	.253
Orientation to other	1.0(.8)	1	.480	0	.119
Initiating event	.2(.4)	**1**	**.024**	0	.309
Event	17.1(12.9)	9	.267	24	.297
Elaborations of detail	6.9(8.4)	8	.449	9	.403
Evaluations	2.9(3.6)	0	.212	5	.274
Conclusion	.2(.5)	0	.313	0	.313
End marker	.83(.9)	0	.179	0	.179
Exposition					
Thesis	2.0(1.0)	**0**	**.022**	1	.160
Sub-category	5.8(4.2)	0	.081	3	.249
Elaborations of detail	2.8(3.1)	0	.182	0	.182
Evaluation	.8(1.3)	0	.271	0	.271
Conclusion	.1(.2)	0	.411	0	.411
End marker	1.1(1.0)	0	.157	0	.157
Persuasive					
Thesis / opinion	2.5(.7)	3	.235	**1**	**.023**
Supporting argument	5.8(2.5)	2	.071	5	.383
Counter argument	1.1(1.2)	0	.194	0	.194
Elaboration	4.0(2.8)	1	.139	2	.233
Evaluation	.6(1.1)	0	.288	1	.349
Conclusion	.8(.9)	0	.187	0	.187
End	.5(.8)	0	.255	0	.255
Narrative					
Orientation to character	2.2(.7)	2	.398	3	.135
Orientation to location	.6(.6)	0	.192	0	.192
Orientation to time	.4(.6)	0	.264	0	.264
Orientation to other	.3(.5)	0	.297	0	.297
Initiating event	1.8(.8)	2	.390	2	.390
Events	17.0(14.2)	5	.271	3	.271
Response/Plan	.4(.6)	0	.199	0	.199
Reflective comments	.7(1.3)	0	.289	0	.289
Elaborations of detail	.9(1.4)	0	.260	0	.260
Conclusion	.7(.7)	1	.358	0	.163
End marker	.7(.8)	0	.186	0	.186

Table 7.5

DL and HB raw scores for oral language, cognitive, and psychosocial assessments and comparison to mean ad standard deviation of reference sample (bolded values indicate significant comparisons).

Assessment	Ref *M*(*SD*)	DL	*p*	HB	*p*
Oral language					
CELF-4 Core Language Score	117.7 (10.4)	**93**	**.009**	103	.080
Cognitive function					
CELF-4 Number Repetition	10.7 (2.6)	**6**	**.038**	8	.151
N-back	3.5 (0.7)	**2.3**	**.040**	2.5	.078
Stop-signal Task	255.8 (103.5)	**456.4**	**.028**	**295.6**	**.035**
Tower Test	1.8 (0.5)	**2.8**	**.010**	2.4	.102
Trail-making	43.7 (36.5)	**129.7**	**.010**	**284.1**	**<.001**
BRIEF-2 Screen	50.9 (8.5	**28**	**.021**	25	.086
RAVLT Immediate	11.3 (2.7)	39	.082	46	.283
RAVLT Delayed	18.8 (4.5)	**6**	**.027**	11	.456
Psychosocial health					
LCQ	61.9 (11.1)	80	.053	49	.124
PedsQL SR Physical	85.0 (10.2)	**56.3**	**.003**	**37.5**	**<.001**
PedsQL SR Psychosocial	75.3 (10.7)	**56.7**	**.042**	**51.7**	**.014**
PedsQL SR Total	78.7 (9.6)	**56.5**	**.011**	**46.7**	**<.001**
PedsQL PR Physical	89.0 (9.3)	**62.5**	**.003**	**31.3**	**<.001**
PedsQL PR Psychosocial	80.0 (12.8)	**56.0**	**.032**	**41.7**	**.002**
PedsQL PR Total	83.2 (10.3)	**64.1**	**.034**	**38.0**	**<.001**
MFAD Problem-solving	1.6 (0.4)	2.2	.068	2.0	.160
MFAD Communication	2.0 (0.3)	2.2	.286	2.2	.287
MFAD Roles	2.2 (0.3)	2.1	.408	2.6	.077
MFAD Affective Responsiveness	1.8 (0.4)	2.3	.178	2.0	.309
MFAD Affective Involvement	3.3 (0.8)	4.0	.192	3.9	.243
MFAD Behaviour control	2.5 (0.6)	3.4	.061	3.0	.204
MFAD General functioning	1.6 (0.4)	2.1	.116	1.8	.284
CASP	97.6 (4.5)	**68.8**	**<.001**	**68.8**	**<.001**

Psychosocial Health

DL. Compared to the complete reference sample, DL demonstrated significantly poorer scores on the CASP (p<.001), PedsQL Self-report Physical (p=.003), Psychological (p=.043), and Total Health scales (p=.011). His scores were also significantly lower for the PedsQL Parent-report Physical (p=.003), Psychosocial (p=.032), and Total Health scales (p=.034). For these assessments, lower scores indicate poorer psychosocial health. These results were consistent with comparisons to the 12-year-old reference subgroup. DL obtained significantly lower scores on the PedsQL Self-report Physical, (p=.004), Psychosocial (p=.040), and

Total Health scales (p=.008), and the PedsQL Parent-report Physical (p=.002) and Total Health scales (p=.046), while the Psychosocial Health scale approached significance (p=.057). No significant differences were observed for the LCQ or MFAD subscales relative to the complete reference sample (see Table 7.5) and age-matched subgroup (see Appendix J.6).

HB. A similar profile was observed for HB. Compared to the complete reference sample, HB obtained significantly lower scores on the CASP (p<.001), and the PedsQL Self-report Physical (p<.001), Psychosocial (p=.014), and Total Health scales (p<.001). He also received significantly lower scores on the Parent-report Physical (p<.001), Psychosocial (p=.002), and Total Health scales (p<.001), see Table 7.5. Similar results were observed when compared to the 14-year-old reference sub-group. Compared to his age-matched peers, HB obtained significantly lower scores on the CASP (p<.001), and the PedsQL Self-report Physical (p<.001), Psychosocial (p=.011), and Total Health scales (p<.001), as well as the Parent-report Physical (p<.001), Psychosocial (p=.002), and Total Health scales (p<.001), see Appendix J.6. As with DL, no significant differences were observed for the LCQ or MFAD subscales relative to the complete reference sample or 14-year-old subgroup.

Discussion

The objective of the current study was to obtain detailed profiles of discourse skills in two participants with ABI by administering the CUDP-A alongside a larger battery of oral language, cognitive, and psychosocial tasks. By comparing participants' performance to the adolescent reference data across domains of assessment presented in Chapter 6 (Study 5), this study sought to explore concomitant deficits across these areas of assessment, and identify potential patterns in performance.

We hypothesised that both cases would demonstrate poorer performance on the CUDP-A relative to the mainstream reference data. It was also predicted that both cases would demonstrate significant impairments in cognitive function and psychosocial compared to the reference sample. The patterns of impairment were hypothesised to be consistent with the associations between these domains of functioning observed in previous chapters and the external literature, and in theoretical frameworks previously described in this thesis (Gernsbacher, 1990; MacDonald, 2017). Overall, these hypotheses were supported. The results of this study support the presence of comorbid deficits in spoken discourse, cognitive function, and psychosocial health in adolescents with a history of ABI (Ferré, Ska, Lajoie, Bleau, & Joanette, 2011; Numis & Fox, 2014).

Oral Language

In support of hypotheses, both participants demonstrated general oral receptive and expressive language skills within the average range (Semel et al., 2003). The CELF-4 CLS is obtained from a standardised language assessment that tests skills in word and sentence-level language (Semel et al., 2003). Both cases are consistent with literature demonstrating limited sensitivity of standardised language assessments to the level and nature of cognitive-communication deficits following ABI (Coelho et al., 2005; Turkstra et al., 2015). It is important to note that DL's CELF-4 CLS was significantly lower than the mainstream sample. As the CELF-4 CLS is sensitive to verbal working memory, this result may be reflective of his impaired working memory, which is a common consequence of ABI in childhood (Gorman, Barnes, Swank, Prasad, & Ewing-Cobbs, 2012).

Spoken Discourse

In support of the study's hypothesis, both cases differed significantly from the reference sample on the CUDP-A. Case-control analyses uncovered significant differences across each level of analysis (micro-structural through to super-structural features) for both participants with ABI. Although the discourse skills for adolescents with ABI have been investigated less than adult populations, the results of this study are broadly consistent with past literature that has revealed deficits in discourse-level language in this population (Chapman et al., 2003; Chapman et al., 2001; Chapman et al., 2004). More specifically, the results for both participants provide support to the existing evidence that deficits lie predominantly above the word and sentence-level language features (Coelho, 2007).

Numerically, both cases demonstrated poorer performance compared to the reference sample across most micro-linguistic features, although few statistically significant differences were observed. This is consistent with the view that, in general, speakers with ABI do not exhibit consistent deficits in micro-linguistic discourse features (Coelho, 2007). At the micro-structural level, only results for DL supported notions of reduced cohesive adequacy in discourse following ABI

(Ghayoumi et al., 2015). This is consistent with proposed links between deficits in cohesion and frontal lobe injuries (Coelho, 2002; Ewing-Cobbs et al., 1998; Hartley & Jensen, 1991; Youse & Coelho, 2005), and in-tact cohesion in speakers with right hemisphere damage (Bloom, Borod, Santschi, Pick, & Obler, 1996; Brady, Armstrong, & Mackenzie, 2006). However, contradictory findings have also been reported (Kurczek & Duff, 2011).

For DL and HB, their discourse profiles are consistent with well-established reports of reduced coherence, relevance and efficiency of information transfer (Chapman et al., 2006; Chapman et al., 2001; Reilly, Bates, & Marchman, 1998), and poor structure (Chapman et al., 1992; 2001; Hay & Moran, 2005) following traumatic and non-traumatic ABI. The discourse profiles of both cases were also consistent with literature that has observed macro-structural and super-structural deficits specific to damage to the frontal lobes (Coelho et al., 2012; Ghayoumi et al., 2015; Youse & Coelho, 2005) and right hemisphere damage (Ferré et al., 2011; Sherratt & Bryan, 2012). Overall, the two profiles observed in this study are congruent with the view that discourse in speakers with brain injury exhibit impairments in more complex, macro- to super-structural features (Coelho, 2007).

Chapter 5 of this thesis documented significant effects of genre on discourse skills in the reference group. In particular, the study reported relative difficulty of topic-centred discourse genres (persuasive and expository) for participants without ABI (Berman & Nir-Sagiv, 2007; Lundine et al., 2018; Nippold et al., 2005). Of interest is the different profiles of discourse features for DL and HB across genres. For example, DL differed significantly across all macro-structural features (coherence, relevance, and efficiency) in recount, but only in global coherence in exposition, and efficiency in narrative (CIUpm). Similarly, HB differed significantly in measures of local and global coherence and efficiency (CIUpm) in persuasive discourse, but only local coherence in recount, and no differences in any macro-structural measure in narrative. Task-related differences in discourse impairments have been previously established in limited literature in children and adolescents with ABI, particularly in event-centred (recount and fictional narrative) versus topic-centred genres (expository and persuasive) (Lundine & Barron, 2019; Van Leer, 1999). This study presents only two cases of adolescents with ABI. As a result, further exploration of the influence of discourse genre on performance in this population is warranted. This would inform the contexts in which discourse skills are assessed in order to profile strengths and weaknesses and guide selection of intervention targets in paediatric ABI.

Cognitive Function

Both cases presented in this study obtained results on cognitive assessments that fell outside clinical cut-offs for multiple tasks, and obtained scores significantly below those of the reference sample. This is consistent with the approximation that 70% of individuals with moderate to severe brain injury demonstrate persistent deficits in cognitive function (Rabinowitz & Levin, 2014). Specifically, the findings are congruous with reports of deficits in planning, shifting, inhibition, updating, working memory capacity, and delayed and short-term verbal memory in adolescents with traumatic and non-traumatic ABI (Anderson, Anderson, et al., 2001; Silberg et al., 2016; Sinopoli, Schachar, & Dennis, 2011).

The results also support differences in cognitive profiles characteristic of different lesion locations. Damage to the frontal lobes is typically attributed to impairment in complex cognitive processes, such as executive function, and deficits in complex social cognitions (Bigler, 2013). DL sustained damage predominantly to the frontal lobes of his brain. His performance on cognitive testing supports the typical presentation of higher-level cognitive and behavioural deficits following frontal injuries (Bigler, 2013). Damage to the right hemisphere is typically associated with impaired attention, cognitive flexibility and processing of non-literal information (Barbey, Colom, & Grafman, 2013; Bernard, Lemée, Ter Minassian, & Menei, 2018; Tompkins, 2012). HB sustained damage to 75% of his right hemisphere, and his performance is indicative of difficulties with sustained attention and cognitive flexibility, and relative strengths in higher-level problem-solving and executive processes, which are typically spared in this population (Barbey et al., 2013; Sarter, Givens, & Bruno, 2001).

Psychosocial Health

The two cases presented in this study demonstrated reduced HRQoL across self- and parent-report measures. Both participants presented with physical deficits post-injury (hemiparesis), so the observation of reduced HRQoL in the physical domain was not surprising and is consistent with literature in this population (Schneeberg et al., 2016). Similarly, both cases demonstrated significantly reduced psychosocial HRQoL. This is consistent with past studies documenting reductions in socialisation, friendships, and emotional wellbeing in this population (Trenchard, Rust, & Bunton, 2013). Both adolescents demonstrated reduced quality and quantity of participation, obtaining total summary scores on the CASP that were over six standard deviations below the mainstream sample. This assessment was specifically designed for children and adolescents with ABI, and the results of this study are consistent with those that have documented considerable restrictions to the quality and quantity of social participation on this measure (Bedell, 2004; Bedell & Dumas, 2004).

Results provided equivocal support for reduced family functioning in adolescents with ABI. Both cases demonstrated performance on MFAD (Epstein et al., 1983) subscales that was above published clinical cut-offs, indicating clinical elevated levels of family dysfunction. Elevated scores were observed in particular subscales related to the degree to which family members value, and take interest in, the activities and concerns of other members (Affective Involvement) and the ways in which family members articulate and maintain standards of behaviour within the unit (Behaviour Control) (Epstein et al., 1983). While this provides some support for evidence of reduced family function in these areas in adolescents with ABI (Barney & Max, 2005; Yeates et al., 2004), neither case differed significantly from the reference sample. Research indicates that levels of family dysfunction reduce over time in the case of less severe injuries (Wade et al., 2002). Both participants were in their chronic stage of moderate injuries, which may explain the lack of significant differences to the mainstream sample. Alternatively, the results may reflect potentially high levels of family function before the ABI, which is a strong predictor of outcomes (Wade et al., 2002). No information on premorbid family functioning was recorded in this study.

Results for perceived communication competence also contradicted the hypotheses proposed within the study of reduced psychosocial health in both cases. No differences were observed between participants with ABI and the mainstream sample. This result was unexpected as the LCQ (Douglas, 2010) was specifically designed for use in ABI and has reported reductions in perceived communication ability in adolescents with a history of ABI (Douglas, 2010). Given the presence of significant differences in spoken discourse between participants with ABI and the mainstream sample, these findings may have been influenced by participants' awareness of communication and language skills. Multiple studies have documented evidence of a high prevalence of deficits in self-awareness (anosognosia) following damage to the frontal lobes (Richardson, McKay, & Ponsford, 2014) and right hemisphere (Tompkins, 2012), including poor awareness of deficits related to cognitive-communication (Douglas et al., 2007; McDonald & Flanagan, 2004). It may be valuable for future research to obtain the perspective of caregivers in order to compare the results of self-report and insight into communication impairment (Douglas et al., 2007).

Patterns in Performance across Domains

Both cases presented with concomitant deficits across cognitive, communication, and psychosocial domains of assessment. This is consistent with MacDonald's (2017) model of cognitive-communication, and in line with the biopsychosocial perspective of impairment illustrated by the ICF-CY (WHO, 2007). Discussion of patterns of performance across assessments are interpreted in light of the results of Chapter 6, in which cognitive and psychosocial correlates of discourse were explored within the reference sample, and theoretical frameworks.

Oral language and spoken discourse. Chapter 4 (Study 3) of this thesis described significant relationships between stronger oral language skills and variables sensitive to predominantly micro-linguistic and micro-structural discourse features within the adolescent reference sample (see Appendix G.2). Study 5 revealed oral language as a unique predictor of the processes underlying discourse quantity and word-level inaccuracy in discourse (page 158 onwards). While it is not possible to draw links between oral language and spoken discourse for HB and DL, it is worth noting that neither case demonstrated impairment on the CELF-4 and demonstrated few deficits in micro-linguistic and micro-structural features. The relationship between underlying oral language and discourse skills has been documented in clinical populations that experience cognitive-communication impairments such as ASD (Condouris, Meyer, & Tager-Flusberg, 2003), and is illustrated in theoretical models of discourse processing (Frederiksen & Stemmer, 1993). Given the potential implications for assessment and goal selection, the relationship between underlying oral language and spoken discourse skills in adolescents with a history of ABI warrants further investigation.

Cognitive function and spoken discourse. Literature concerning the relationship between deficits in cognition and spoken discourse in ABI was systematically reviewed in Chapter 2. Both participants with ABI presented profiles of discourse and cognitive impairment consistent with the systematic review, and those described in Gernsbacher's (1990) SBF. Chapter 2 described the role of executive dysfunction and poor memory in discourse impairments in speakers with ABI, particularly for macro- and super-structural deficits. In the current study, both cases were impaired on measures of executive function and verbal memory, and produced discourse that differed from the reference sample predominantly across measures of coherence and discourse organisation.

Both cases presented here may also support the theorised indirect effect of cognitive impairment on micro-linguistic and micro-structural discourse features. Difficulties with coherence and discourse structure observed in both participants may have rendered the numerically poorer performance across measures of lexical, phonological, and morpho-syntactic encoding, as mediated by executive dysfunction and memory impairment. This has been previously proposed in speakers with ABI (Marini et al., 2017), and provide some support for the SBF (Gernsbacher, 1990) and Frederiksen & Stemmer's (1993) model.

Psychosocial health and spoken discourse. Both adolescents with ABI demonstrated significant reductions in discourse skills and aspects of psychosocial health. Only tentative interpretations of these results can be made in light of the findings of Chapter 6 and broader literature that has documented a relationship between discourse and psychosocial outcomes in this clinical population (Elbourn et al., 2019; Galski et al., 1998; Snow et al., 1998). For instance, DL demonstrated clinically elevated scores for the Affective Responsiveness and General Functioning MFAD subscales (Epstein, 1983) and poor global coherence and discourse structure. DL also demonstrated significantly poorer scores on parent-rated measures of psychosocial health and reduced clausal density. Relationships between these discourse and psychosocial variables were observed in the reference sample, suggesting the results of this study could represent an impact of brain injury this relationship (see Table 6.3). Similarly, HB demonstrated reduced fluency, coherence, and discourse structure in the context of reduced physical and psychosocial health and aspects of family function. These relationships were also observed in the reference sample. Few studies have examined the degree to which deficits across cognitive, communication, and psychosocial domains co-occur, or are related, in adolescents with ABI (Elbourn et al., 2019). The results of this pilot study are consistent with MacDonald's (2017) model and WHO ICF-CY (WHO, 2007), and provide support for current recommendations to consider cognitive and psychosocial factors in clinical decision-making for discourse deficits in this population (Morgan et al., 2017).

Clinical Implications

The results of this study have implications for clinical practice for discourse-level deficits in adolescents with ABI. First and foremost, this study has highlighted the importance of assessing discourse-level language in paediatric ABI and has demonstrated the utility of the CUDP-A (Hill et al., 2020) as an assessment of monologic discourse in this population. While both participants performed within the average range on a gold-standard oral language assessment, the CUDP-A and corresponding reference data were effective in identifying the level (i.e micro-linguistic to superstructural) and nature of disordered language at the discourse level in two adolescents with ABI. The variability in significant results observed across levels of analysis and between genres highlights the importance of assessing a range of language features and types of discourse required across academic and social environments to profile a range of strengths and weaknesses in discourse skills (Coelho et al., 2005). The findings also support the use of Crawford and Howell (1998) modified *t* tests to perform single-case control comparisons to the reference data presented in this thesis. By using this freely available software, clinicians are able to compare clients' individual scores to the descriptive reference data across age groups and genders presented published in Hill et al. (2020).

Second, the findings of this study contribute to our understanding of comorbid impairments in cognitive and psychosocial domains that may present in our clients with discourse-level deficits post-ABI. Both cases presented in this study represent profiles of injury aetiology, lesion location, and demographic factors that are likely to be encountered in clinical practice. As such, the results may support clinical decision-making by encouraging a holistic approach to assessment and treatment planning. This supports published recommendations that advocate for consideration of psychosocial issues and cognitive impairment when selecting treatment targets and designing treatment for cognitive-communication deficits in this population (CASLPO, 2018; Morgan et al., 2017).

The findings of this study also reinforce the dynamic, and multi-faceted conceptualisation of cognitive-communication disorders illustrated in MacDonald's (2017) model. This model documents the potential for concomitant, and potentially related, deficits in communication, cognitive, and psychosocial function. While it was not possible to draw stronger conclusions regarding the nature and extent of relationships between domains of function across two participants with ABI, the results still support this theoretical model and its application within clinical practice in the area of paediatric ABI.

Limitations and Future Directions

The results of this study should be interpreted in light of methodological limitations. Firstly, it was not possible to draw stronger conclusions regarding the cognitive and psychosocial correlates of spoken discourse skills due to the small sample size. While the use of single cases allowed for interpretation of discourses skills in light of individual variation and performance on cognitive and psychosocial measures, future research should recruit a larger number of participants. A larger case series would allow for the identification and comparison of numerous profiles that reflect the variability seen in clinical practice. This would also support the findings of group-level designs that conduct more rigorous statistical analysis of the relationship between discourse, cognitive, and psychosocial variables. Future studies may also extend the recent work of Elbourn et al. (2019) and conduct longitudinal research into the association between cognitive, discourse, and psychosocial outcomes of adolescents with ABI. This would have implications for clinical decision-making; particularly for goal-setting and development of accurate prognoses for discourse as they relate to function in other domains.

As discourse data were obtained using the CUDP-A, the variables analysed have been elicited in the context of monologic discourse only. Conversational discourse forms a critical part of daily social and academic interaction, and has been identified as a particular area of impairment in speakers with ABI (Coelho, Youse, & Le, 2002; Turkstra, 2000). Future research should examine interactive, the cognitive and psychosocial factors related to dialogic discourse in adolescents with and without ABI. Similarly, Chapter 6 described evidence of genre-related differences in discourse skills within the mainstream comparison sample. It was interesting to observe differences between participants with ABI and the comparison group were inconsistent across genres. As discussed previously in this thesis, monologic genres are believed to differ in their cognitive demands and role in daily life (Berman & Nir-Sagiv, 2007; Bliss & McCabe, 2008). The cognitive and psychosocial factors associated with discourse impairments in speakers with ABI may, therefore, differ across genres. This may influence the nature and extent of discourse deficits following ABI, and their impact on psychosocial outcomes across formal and informal environments (Bliss & McCabe, 2006). This is an important avenue for future research, as it has clear relevance for clinical decision-making such as the contexts, tasks, and targets of assessment and intervention.

Conclusions

The final empirical study of this thesis has contributed to our understanding of discourse in adolescents with ABI relative to a mainstream adolescent cohort. The results provide further support for the assessment of discourse skills in adolescents with ABI. In particular, the findings support the utility of the CUDP-A to assess monologic discourse in this population. By using Crawford and Howell (1998) modified *t* tests, clinicians and researchers can compare individuals with ABI to age- and gender-matched reference data across levels of analysis and genres. This study is unique in its single-case approach to profiling performance across communication, cognitive, and psychosocial domains relative to mainstream adolescent peers. Consistent with the broader ABI literature, the results support the presence of comorbid deficits across communication, cognitive, and psychosocial domains of function in adolescents with ABI. Although limited to a descriptive analysis, patterns in impairment across cognitive, discourse, and psychosocial domains were partially consistent with the relationships documented in previous chapters and within external literature. These findings are broadly congruent with links between domains of function presented in both Gernsbacher's (1990) SBF and MacDonald's (2017) model of cognitive-communication, which supports the application of these theoretical models in ongoing research and current clinical practice.

Chapter 8
General Discussion

This final chapter summarises the key findings from this program of research. This chapter also outlines the unique theoretical and clinical implications of this research, as well as its limitations and directions for future studies.

Adolescents with a history of ABI are at risk of ongoing impairments in cognition, communication, and psychosocial health. Cognitive-communication deficits, in particular, place an individual at risk of reduced communicative success, social isolation, and negative psychosocial outcomes (MacDonald, 2017; Turkstra et al., 2015). A focus on discourse-level language skills is a valuable way to assess and manage cognitive-communication deficits as they relate to functional, real-world impact (Coelho, 2007). MacDonald's (2017) model (Figure 1) illustrates cognitive-communication as a multi-faceted and dynamic construct. An awareness of deficits within each domain of functioning in MacDonald's (2017) model, and potential relationships between them is imperative for evidence-based and holistic clinical decision-making (MacDonald, 2017; Morgan et al., 2017). This knowledge also forms a critical foundation to ongoing treatment efficacy research (Whyte et al., 2009). Despite this, few studies have explored links between cognitive, psychosocial, and discourse impairments in adolescents with ABI. As such, there may not be sufficient understanding to inform evidence-base practice to (Coelho, 2007; Turkstra et al., 2015; Whyte et al., 2009; 2014). This is further confounded by the paucity of empirical studies and clinical resources available to guide assessment and treatment planning for discourse skills in this clinical population (WHO, 2007). In response, the overarching objective of this thesis was to explore the cognitive and psychosocial correlates of spoken discourse in adolescents with ABI.

Summary of Findings

Part One of this thesis aimed to scope the existing literature and current clinical practice as they relate to discourse in adolescents with ABI and its links to cognitive and psychosocial outcomes. The systematic review was conducted to synthesise the literature on links between cognitive and discourse impairments in speakers with ABI. The review (Study 1) provided consistent evidence of an association between disordered cognition and discourse skills in this population, particularly in executive function and memory processes. The relationships observed across studies were also largely congruent with the stages and processes involved in Gernsbacher's (1990) SBF. Despite this, the review highlighted critical gaps in the literature, including those related to limited literature on discourse in paediatric ABI as well as inconsistency in methods to assess discourse skills and cognitive functioning. Assessments of adolescent discourse are in their naissance relative to standardised batteries of word and sentence-level language features, so it was not surprising to some inconsistencies across the studies included in the review. Furthermore, while methods to assess discourse-level language are gaining increasing attention, efforts should be focused on translating this research into clinical practice and greater consistency in empirical studies. The systematic review also highlighted the dearth of literature concerning links between cognition and discourse in children and adolescents with and without ABI. Few studies had involved a control or comparison group where links between cognition and discourse were examined, and only one of which was paediatric. This contributed to a poor understanding of how cognitive function *typically* subserves discourse skills. This was identified as a substantial gap to understanding disordered adolescent discourse as 'the very definition of disordered depends upon the understanding of normality and normal variation' (Hollands, 1990, p.37).

The first international survey of clinical practice for assessment and treatment of discourse in paediatric ABI was subsequently conducted to scope practice as the second study in Part One of this research program. The results of this study (Chapter 3) indicated clinicians aspire to align with current recommendations for this population (CASLPO, 2018; Morgan et al., 2017). Clinicians described a generally biopsychosocial approach to clinical decision-making, aligning with a multi-faceted perspective of communication disability in clinical populations (MacDonald, 2017). In particular, clinicians recognised the value in discourse-based assessment and intervention, frequently targeting language at the discourse-level in this population. This result contradicted that of Frith (2014) who observed infrequent assessment of language at the discourse-level. As five years have passed since Frith's (2014) study, the results presented in Study 2 may reflect more recent publication of clinical guidelines (e.g. CASLPO, 2018; Morgan et al., 2017), as well as a growing body of literature on child and adolescent discourse across clinical and non-clinical populations (Channell et al., 2018; Dipper & Pritchard, 2017; Nippold et al., 2017; Westerveld & Vidler, 2016), including cognitive-communication in paediatric ABI (e.g. Cermak et al., 2019; Laane & Cooke, 2020; Turkstra et al., 2015). The results did indicate, however, that clinicians' efforts to assess discourse to inform treatment planning remain thwarted by the lack of standardised discourse assessment tools and corresponding normative data. Other, well-known, barriers to discourse assessment also remain such as time and limited awareness of how results inform evidence-based intervention (Westerveld & Claessen, 2014). Clinicians' responses were generally consistent with key issues identified in the systematic review that related to the lack of age-appropriate discourse assessment tools, normative reference data, and limited understanding of correlates of discourse impairments in this population.

These caveats were addressed in Parts Two and Three of this research program. The CUDP-A (Hill et al., 2020) was developed and reference data were collected from a large cohort of adolescents that represent a mainstream academic classroom in Western Australia (Study 3). The CUDP-A is a reliable assessment of adolescent discourse (see page 101) with preliminary evidence of its validity in significant correlations with a gold-standard standardised assessment of oral language (see Appendix G.2). Using the CUDP-A, this strand of the research also documented significant genre-related differences in adolescent discourse skills (Study 4).

Drawing on the reference data obtained in Study 3, Part Three of this thesis documented significant links between adolescent discourse and cognitive and psychosocial domains of function (Study 5) that were largely consistent with broader literature in typical and non-clinical populations (Delage & Frauenfelder, 2019; Hay & Moran, 2005; Hickmann, 1980; Leclercq & Majerus, 2010). These links were also congruent with those stages and process of Gernsbacher's (1990) SBF, particularly the role of executive function and memory in the retrieval and organisation of discourse content. By aligning with the SBF, the results provide preliminary insight into potential cognitive mechanisms of disturbance for discourse following childhood ABI, yet the link to psychosocial outcomes was more ambiguous. Some univariate relationships were observed within the mainstream sample, such as the link between quality of life, family function and discourse-level language, which was consistent with previous studies of paediatric (Aguilar et al., 2019) and adult ABI (Elbourn et al., 2019; Galski et al., 1998). The results do suggest that further exploration of the psychosocial correlates of spoken discourse may be better conducted within clinical populations at risk of reduced psychosocial outcomes and do not perform close to ceiling on objective measures.

In line with MacDonald's (2017) model, two adolescents with ABI demonstrated concomitant impairments in cognitive function, psychosocial health, and spoken discourse across micro-linguistic to super-structural features on the CUDP-A (Hill et al., 2020). Profiles across domains of function were consistent with external literature, and the pattern of impairments reflected those described in previous chapters of this thesis. Together, results from the mainstream adolescent reference sample and two participants with ABI provided preliminary support for biopsychosocial frameworks of disability (WHO, 2007) and cognitive-communication (MacDonald, 2017). This body of research is unique in its discussion of the nature of, and patterns in, cognitive, communication, and psychosocial function in adolescents with and without ABI and development of a standardised adolescent discourse protocol and reference data.

Clinical and Theoretical Implications

The Curtin University Discourse Protocol – Adolescent. The CUDP-A and reference data presented in this thesis make a significant contribution to the literature on discourse assessment. The lack of consistent recommendations for adolescent discourse assessment is a well-established barrier in clinical practice, particularly in the absence of a variety of standardised guidelines available for elicitation and scoring of multiple language features of a range of discourse genres (Coelho, 2007; Frith, 2014; Westerveld & Claessen, 2014). The CUDP-A adds to the existing, albeit restricted, range of protocols available for adolescent discourse assessment such as those for persuasive (Heilmann et al., 2020), expository (Heilmann & Malone, 2014; Nippold et al., 2005), and narrative assessment (Lundine et al., 2018; Nippold et al., 2014). The CUDP-A is unique, however, in that it provides researchers and clinicians a method to elicit recount, narrative, expository, and persuasive discourse in adolescents. Furthermore, the CUDP-A provides large sets of reference data for word to whole-text features taken from the same sample of adolescents using a theoretically-based scoring protocol. Chapter 6 provided support for the reliability and validity of the CUDP-A and the results in Chapter 7 confirm the CUDP-A elicits distinguishable discourse samples across recount, narrative, expository, and persuasive discourse. The protocol also distinguished discourse samples between adolescents with and without ABI. This provides support for the use of the CUDP-A to characterise discourse in this clinical population, and the use of reference data to identify strengths and weaknesses in discourse across genres. Differences in spoken discourse between participants with and without ABI were identified using Crawford and Howell (1998) modified *t*-tests, which supports the use of this analysis in clinical practice (freely available to download, here: https://homepages.abdn.ac.uk/j.crawford/pages/dept/SingleCaseMethodology.htm).

The CUDP-A is now a freely available, published, protocol (available here: https://www.tandfonline.com/doi/full/10.1080/02699206.2020.1731607), which addresses critical empirical and clinical barriers related to the dearth of appropriate assessments for this population. The CUDP-A is expected to facilitate ongoing research and broadening knowledge of discourse-level language skills, and their impairment, across a range of clinical populations.

Macdonald's model of cognitive-communication. The results of Study 5 and Study 6 provide particular support for the domains included in MacDonald's (2017) model of cognitive-communication, including evidence of links between them in adolescents without ABI. The final empirical study presented described two cases of adolescents with ABI who demonstrated impairments in spoken discourse, alongside those of cognitive function, and psychosocial health relative to the reference sample. Furthermore, tentative comparisons could be made between patterns of performance across domains observed in the adolescents with ABI and those observed in the reference sample in Chapter 8. Poorer performance on CUDP-A measures was observed in the context of poorer scores on measures of executive function and verbal memory. Some preliminary links between discourse and psychosocial outcomes were also observed, such as the relationship between discourse features, quality of life, and family functioning. The results provide support for the use of MacDonald's (2017) model in clinical practice and ongoing empirical research to inform our understanding of links between domains of function. In particular, the findings advocate for the consideration of comorbid deficits across these domains in clinical decision-making as it is encouraged in current guidelines (Morgan et al., 2017).

By including multiple domains of functioning, a primary objective of MacDonald's (2017) model is to encourage consideration of interdisciplinary literature and collaboration. For example, the links observed between cognition and discourse suggest value in considering consultation or literature in the field of neuropsychology. The presence of concomitant deficits in cognition, communication, and psychosocial outcomes for quality of life, participation, and family function may indicate value in consulting clinical psychology, social work, and educators (MacDonald, 2017). Interestingly, Study 2 described infrequent involvement of a range of disciplines in assessment and treatment planning for discourse in paediatric ABI. This calls for ongoing advocacy for multidisciplinary practice for cognitive-communication in this population, which would be supported by ongoing research into links between communication deficits and cognitive, psychosocial, and academic outcomes (Rivara et al., 2012; Togher et al., 2014). Overall, the findings of this research program support the continued application, and further validation, MacDonald's (2017) model in paediatric ABI. In doing so, MacDonald's (2017) perspective of cognitive-communication as a multi-faceted, complex, constructs will directly support a more holistic and interdisciplinary approach to clinical decision-making and empirical research in this population (MacDonald, 2017; Steel & Togher, 2019). This is particularly relevant for ongoing treatment efficacy research, where the knowledge of the cognitive underpinnings and real-life psychosocial impact of cognitive-communication is critical for rehabilitation development (Whyte et al., 2009; Whyte, 2014).

Frederiksen and Stemmer's discourse processing model. Frederiksen and Stemmer's (1993) model of discourse processing was adopted here to represent the processes and knowledge stores involved in discourse production and, as such, guided the selection of word to whole text-level language variables to be assessed by the CUDP-A. These features were then categorised using Coelho's (2007) framework within micro-linguistic, micro-structural, macro-structural, and super-structural levels.

Collectively, the results of this research program support the top-down and bottom-up language processing described in Frederiksen and Stemmer's (1993) model. This model posits that some discourse measures tap into more than one stage of lexical and conceptual processing and, therefore, more than one feature of discourse. This was particularly supported by the significant correlations between performance on the CELF-4 (Semel et al., 2003), a standardised assessment of word- and sentence-level language, and micro-linguistic to super-structural measures on the

CUDP-A. Study 3 also reported correlations with and between levels of analysis on the CUDP-A. These findings support the complex links between word and whole-text level language processes illustrated in Frederiksen and Stemmer's (1993) model. This was also evident in the results of dimension reduction reported in Study 5, where CUDP-A variables did not load onto micro-linguistic to super-structural factors as suggested by Coelho's (2007) framework. Together, these findings lend support to the conceptualisation of discourse as a dynamic, interactive process, although they indicate greater attention needs to be paid to exploring the underlying language features tapped into by discourse measurements. The application of a clear framework for discourse measures is necessary for clear terminology and consistency in research. If those variables could be isolated that were more sensitive to deficits in underlying language behaviours, the ease with which levels of breakdown in discourse could be identified would be increased, thereby facilitating the use of discourse assessment in clinical contexts. This may also increase the potential to study the correlates of discourse skills given fewer variables may be required to characterise discourse impairment. This would also inform our theoretical understanding of the underlying language processes required in discourse production and how to best characterise these processes in clinical populations.

The Structure Building Framework. Gernsbacher's (1990) SBF was used in this thesis as a theoretical account of the involvement of cognitive function in the discourse production process. The results provide empirical support for the process by which discourse processing draws on cognition as described in the SBF. The findings across studies support the role of executive function and memory in the retrieval, organisation, and sequencing of relevant content, as it occurs in the stages of laying the foundation, mapping relevant content, and shifting to create new episodes (Gernsbacher, 1990). The results further support the use of the SBF as a valuable framework within which to conduct more comprehensive investigation of the cognitive correlates of discourse skills in clinical populations. In the absence of available evidence on the cognitive correlates of discourse in paediatric ABI, the results of this thesis advocate for the use of the SBF in clinical practice. By having a validated theoretical model that describes the link between discourse and cognition, clinicians may be better equipped to identify level(s) of breakdown in discourse, interpret discourse assessment, and identify appropriate targets for intervention (Coelho, 2007; Gernsbacher, 1990).

Limitations and Future Directions

This body of research was subject to several limitations. This research program was subject to general limitations in statistical power. For instance, the clinician survey recruited a smaller sample than others that have surveyed assessment and intervention practices in clinical populations, including adults with ABI (Frith, 2014; Westerveld & Claessen, 2014). This impeded a comprehensive analysis of factors influencing clinical practice such as demographic factors, or the relationship between assessment and treatment practices. Power limitations also restricted the formation of stronger conclusions regarding the cognitive and psychosocial correlates of spoken discourse in adolescents with and without ABI. Although a sample size of 160 was sufficient in size to detect variability in discourse skills in adolescents without ABI (Studies 3 and 4), it was not sufficient for a more comprehensive analysis of correlates of discourse in the reference sample, such as the analysis of individual variables across domains of assessment and across genres. Similarly, it was not possible to explore the correlates of discourse in adolescents with ABI due to only having two participants after unexpected challenges with recruitment from this clinical population. Future studies should endeavour to recruit a larger sample of adolescents with ABI as multiple case studies may facilitate an exploration of the patterns of deficits encountered in clinical contexts.

It is important to note the generalisability of the findings of this research program to adolescents with and without ABI. We purposefully recruited adolescents that represented the mainstream cohort in years 7 to 10, spoke English as their first language, had no history of language delay or disorder, and were recruited from a metropolitan area. The use of CUDP-A reference data presented in this study is therefore, necessarily, limited to adolescents who fit these criteria. Similarly, the findings of Study 6 in relation to discourse in two adolescents with ABI is not generalisable to the wider population of adolescents with brain injury The ongoing development of a comprehensive database of adolescent discourse from mainstream and clinical populations with wider age ranges, and more diverse linguistic and cultural backgrounds is a priority to detect stability, or otherwise, and subtle nuances in discourse skills (Mäkinen et al., 2014; Steel & Togher, 2019; Westerveld & Vidler, 2016). By recruiting a larger, more diverse sample, or larger clinical groups, future investigations may be also better place to detect small to moderate relationships between domains of function. Alternatively, as discussed in Chapter 8, future studies may benefit from adopting dual-task paradigms within mainstream populations to induce sufficient variability to detect relationships between constructs (Hegarty et al., 2000).

The final limitation relates to assessments used to profile discourse and psychosocial health. The CUDP-A was developed to assess adolescent discourse across for monologic not dialogic genres. Consequently, the results presented in this thesis do not represent adolescent conversational discourse. Future studies should build on the work of Nippold et al. (2005; 2013) and examine the development and characteristics of conversational discourse throughout adolescence, including the cognitive and psychosocial factors associated with conversational skills at this age. This should be a priority as conversational discourse is critically important for social participation and wellbeing at this age (Turkstra, 2000). This data may also not reflect skills in other monologic genres or tasks such as procedures, descriptions, or narrative retell, which are required for social and academic participation (Bliss & McCabe, 2012; Snow et al., 1997). Future studies may benefit from investigating the cognitive and psychosocial correlates of other monologic and dialogic genres. An enhanced awareness of these links will have implications for selection of assessment and treatment contexts that are sensitive to cognitive deficits and to the difficulties experienced in real-world interaction. Psychosocial assessments administered in this research program were developed for clinical populations, including paediatric ABI (McCauley et al., 2012). They may have had limited sensitivity to variability in quality of life across within the reference sample of adolescents with no immediate risk to physical or mental health (Eiser & Morse, 2001). Studies of psychosocial health in the general adolescent population may consider using more subjective measures of psychosocial outcomes, or those not directly sensitive to health-related psychosocial outcomes. Researchers may also adopt qualitative methodology to explore individual and caregiver reports of discourse skills and their role in daily participation, wellbeing, and functioning within daily environments.

Conclusion

This thesis explored the cognitive and psychosocial correlates of discourse skills in adolescents with and without brain injury and implications for assessment and intervention in this clinical population. There has been little attention paid to exploring the factors associated with discourse skills in adolescents with ABI. This is a critical consideration in current clinical practice and underpins ongoing intervention research (Morgan et al., 2017; Whyte et al., 2009). The results of this thesis provide preliminary evidence of the cognitive and psychosocial factors that are related to spoken adolescent discourse. Adolescents with ABI can experience concomitant deficits in cognition, discourse, and psychosocial health that may influence their daily communication competence. This thesis also presents a novel assessment tool with corresponding reference data and promising psychometric properties. This research has identified the current barriers to clinical practice in paediatric ABI, and clinicians' perspectives on priorities for future research. This will provide researchers with clear direction for ecologically valid and clinically relevant studies in paediatric ABI. These findings are expected to inform ongoing exploration into discourse in adolescents with ABI, and contribute to effective and ecologically valid methods to remediate discourse impairments in this population. Greater opportunities for positive, long-term outcomes for communication competence and psychosocial outcomes for adolescents with a history of ABI can only be enhanced through such endeavours.

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Appendices

Appendix A Additional Methodological Information

Participants without ABI

To form the adolescent reference sample, we purposefully recruited a sample of adolescents without ABI (*N*= 160) that reflected a mainstream academic classroom in Western Australia. To be eligible for participation within the mainstream reference sample, participants were to be between 12;0 to 15;11 years of age, attend mainstream school, speak English as their first language (as reported by the parent) and not have a diagnosis of autism spectrum disorder (ASD), intellectual disability, or ABI. Participants were also required to have adequate visual, physical, and auditory acuity in order to participate in assessments involving spoken communication and the physical and/or visual manipulation of test items. Participants could have a history of Speech Pathology intervention providing they met the inclusion criteria for the study.

Ethics and Recruitment

Ethics approval was gained from Curtin University (HRE2016-0219), Catholic Education Western Australia (June 2017; RP2017/31), and the Department of Education Western Australia (May 2018; D18/0182330). Following ethics approval, principals and other relevant members of staff (i.e. school psychologists and members of pastoral care teams) of private, independent, and Government-funded schools were contacted regarding the project. Schools were asked to disseminate the appropriate recruitment materials provided in Appendix E to students, parents, and staff via email circulation and/or the school's print and online media. Four schools were recruited in this manner. In addition to school-based promotion, recruitment material was disseminated by community-based organisations relevant to the adolescent age-group, and by members of the research team via social media posts on Facebook and Twitter. Hardcopy project flyers were also placed in Speech Pathology clinics, community libraries, medical centres, sporting centres, and other shared public areas around Perth.

Participant Demographics

The adolescent reference sample comprised 160 adolescents without brain injury, 46% male 54% female. Participants comprised four age groups: 12;0-12;11 (*n*=33, *M*=12;4, *SD* = 0;4), 13;0-13;11 (*n*=50, *M*=13;5, *SD*=0;4), 14;0-14;11 (*n*=39, *M*=14;5, *SD*=0;4), 15;0-15;11 (*n*=38, *M*=15;5, *SD* = 0;4) and ranged in age (years) from 12;0 to 15;11 (*M*= 13;1, *SD*= 1;1). Participants were enrolled in Australian mainstream schools across grade six (*n*= 1), seven (*n*=30), eight (*n*=49), nine (*n*=37), and ten (*n*=43). Parents of 28 participants (18%) reported a history of Speech Pathology intervention for articulation/intelligibility (*n*=18), stuttering (*n*=6), and literacy (*n*=4).

Assessment Procedure

Participants attended two 45 to 60-minute assessment sessions with a qualified speech pathologist to complete a battery of assessments across cognitive, communication, and psychosocial domains. Participants chose whether sessions occurred at their home or at Curtin University's Health and Wellness Centre. A subset of participants recruited from a private school in Perth (*n*= 27) were seen during school hours. For these participants, session times and days were negotiated with school staff to minimise disruption to student learning. All language and discourse assessments were administered in the first session and cognitive assessments during the second assessment session. Psychosocial health measures and a demographic questionnaire were completed via Qualtrics in the participants' and parents' own time. The Qualtrics survey was disseminated via an anonymous link sent via email. Parents were provided the opportunity to receive a summary of their child's performance on standardised language and cognitive assessments. Results on psychosocial health measures were only provided if their scores indicated cause for concern (*n* = 2). The caregiver(s) of those participants who demonstrated cause for concern on psychosocial and cognitive measures were contacted by a senior clinical psychologist within the School of Psychology at Curtin University to discuss the assessment results. Participants who demonstrated cause for concern on oral language assessments were provided with the details of their closest speech pathology services. See Appendix E.2 for a sample assessment report. Each participant involved in the project received a movie voucher in appreciation of their participation.

Assessment of Spoken Discourse

Samples of spoken discourse were collected from each participant using a novel assessment tool designed specifically for this thesis. The Curtin University Discourse Protocol – Adolescent (CUDP-A) (Hill, Claessen, Whitworth, & Boyes,

2020) elicits 11 discourse samples from each participant across monologic event- and topic-centred genres. The protocol is a modified version of the Curtin University Discourse Protocol (Whitworth et al., 2015) originally designed for use with adults. The CUDP has demonstrated good to excellent stability in healthy adults (Whitworth et al., 2018), and good to excellent stability has in adult clinical populations (Beales, Whitworth, Cartwright, Panegyres, & Kane, 2018). The CUDP-A maintains the same structure and elicitation procedure as the adult tool, with updated discourse genres, topics, and analysis procedures relevant to the adolescent population. The tool assesses samples of personal recount (*n*=3), expository (*n*=3), persuasive (*n*=3), and fictional narrative discourse (*n*=2). These genres were chosen due to their role in daily socialisation and relevance to the academic requirements of mainstream Australian classrooms across years 7 to 10 (Australian Curriculum, Assessment, and Reporting Authority [ACARA], 2015).

For personal recount, participants were asked to describe their weekend, the events occurring around a recent accident or injury (for example, falling off a bike), and their most recent holiday. For the fictional narrative tasks, participants were shown two Norman Rockwell paintings: 'The Runaway' (Rockwell, 1958) and 'Young Lady with the Shiner' (Rockwell, 1953), and asked to tell a story, in their own words, about the image. These picture stimuli have been used in past studies examining narrative production in speakers with and without brain injury as they are interpretive and can generate a number of different conceptual responses (Coelho, 2002; Kurczek & Duff, 2011; Liles, Coelho, Duffy, & Zalagens, 1989). For the expository samples, the goal was to elicit an objective and factual discourse. Participants were asked to describe what they know, including their thoughts and ideas on bullying, social media, and obesity. These topics were chosen due to their contextual relevance to adolescents and their presence in the current curriculum for years 7-10 (School Curriculum and Standards Authority, 2013; 2017). For the Persuasive samples, participants were asked to provide their opinion on three topics, "whether social media is a bad influence on teenagers", "whether school uniforms should be compulsory", and "whether sport should be a compulsory subject at school". Participants were given as much time as necessary to plan their responses, and indicated to the researcher for the recording to begin. Topic adaptations of a similar difficulty were available where topics were unfamiliar to the participant. During the elicitation of each sample, the interviewer responded to the participant with continuation regulators only (e.g. "Is there anything else you'd like to tell me?") and non-verbal prompts such as head-nods, facial expressions, and eye-contact. Administration time for the CUDP-A varied between 10 and 30 minutes across participants.

Transcription and analysis. All discourse responses were recorded using an OLYMPUS VN-74IPC digital voice recorder (Olympus, Tokyo) and transcribed into the research version of Systematic Analysis of Language Transcripts (SALT) software (Miller & Iglesias, 2018), segmented into 'communication units' (c-unit; Loban, 1976), and analysed using study specific codes. See Appendix F.2 for the CUDP-A scoring protocol. To align with broader literature and Frederiksen and Stemmer's (1993) model, CUDP-A measures were sensitive to a range of word- to whole-text level features. These measures were categorised according to Coelho's (2007) framework into micro-linguistic, micro-structural, macro-structural, or super-structural levels of analysis.

All participants' discourse responses were audio-recorded and transcribed into Systematic Analysis of Language Transcripts (SALT) software (Miller & Iglesias, 2018), segmented into 'communication units' (c-unit; Loban, 1976), and analysed using study specific codes (Appendix F.2). Two final-year Speech Pathology students at Curtin University were recruited to check accuracy of discourse transcription. These students were required to listen to recordings and edit transcripts. Inter-rater reliability of transcription was indexed by percent agreement. C-units were defined as a main clause (for example, the boy kicked the ball) plus any subordinate clauses, for example, the boy kicked the ball, *before he ran away*, or subsequent co-ordinating clauses where the subject was carried over, for example, the boy kicked the ball *before tripping on a rock* (Loban, 1976; Westerveld & Vidler, 2016). To align with broader literature and Frederiksen and Stemmer's (1993) model, CUDP-A measures were sensitive to a range of word- to whole-text level features and categorised into Coelho's (2007) micro-linguistic, micro-structural, macro-structural, or super-structural levels of analysis. Measures within each level of analysis were calculated independently or obtained from the Standard Measured Report generated through the research version of SALT software (Miller & Iglesias, 2018). One trained judge (SC) also independently coded 10% of the samples (n=16) for all discourse measures All points of disagreement were discussed with a member of the research team and agreement reached. Scoring instructions were updated if required. Inter-rater reliability for coding was indexed by intra-class correlation coefficients (ICC). This data is presented in Chapter 4. The micro-linguistic to super-structural discourse measures included in the CUDP-A scoring protocol are outlined in detail, below.

Micro-linguistic measures. Micro-linguistic variables measured within-sentence features including productivity, syntactic complexity, lexical diversity and fluency (Coelho, 2007). Productivity was measured using total number of c-units (Loban, 1976). Syntactic complexity was measured using indices of morpho-syntactic complexity and clausal density. Morpho-syntactic complexity was indexed using mean length of utterance in words (Miller & Iglesias, 2018). Clausal density was calculated by dividing the total number of clauses by total c-units (Nippold, 2010). Lexical diversity was measured using the number of different words (Miller & Iglesias, 2018), and fluency was measured using the total number of mazes and percentage of maze words (%maze words; Miller & Iglesias, 2012).

Micro-structural measures Micro-structural variables measured across-sentence features including the frequency and adequacy of referential cohesion (Van Leer & Turkstra, 2005). This thesis focusses on the frequency and adequacy of referential cohesion, specifically, due to the importance of referential ties in maintaining continuity and surface structure in discourse (Martinková, 2013). A referential tie links the semantic concept of a character, idea, or element in the discourse to the same referent in another part of the text, and takes the form of a personal or demonstrative marker (Halliday & Hasan, 1976). Using Liles' (1985) procedure, each referential tie was judged as either complete, incomplete, or erroneous. A *complete* tie was one for which the referent could be located easily within preceding utterances. An *incomplete* tie was one for which the referent was not previously provided or was not evident from the text. An *erroneous* tie was one for which more than one possible referent could be inferred from the discourse (Liles, 1985). Frequency of cohesion was measured by the total number of referential ties in the discourse sample. Adequacy was calculated by diving the number of complete ties by the total number of ties in the sample (Liles, 1985).

Macro-structural features. Macro-structural variables measured between-sentence features including coherence (local and global), relevance, and efficiency

(Coelho, 2007). Local and global coherence were measured using Glosser and Deser's (1990) rating scales, where higher ratings indicate better coherence (utterances are rated between one and five). For each participant, an average local coherence and global coherence rating was calculated for each genre. Nicholas and Brookshire's (1993) Correct Information Unit (CIU) analysis was used to measure relevance and efficiency of information transfer (Coelho, 2007). Relevance was measured using the percentage of correct information units of total words (%CIU). Efficiency of information transfer was measured by calculating the number of CIUs produced per minute of discourse (CIUpm; Nicholas & Brookshire, 1993). Each participant obtained an average %CIU and CIUpm for each genre and their overall CUDP-A sample.

Super-structural features. Super-structural variables captured the organisation and structure of discourse content. At the super-structural level, discourse is frequently characterised using measures that assess a speaker's use of discourse schema; a framework, which guides the production of information according to logical, causal, or temporal relationships between concepts or ideas (Coelho, 2007). These frequently include measures of story grammar and provision of crucial schema components or 'completeness' in the context of narrative production as well as tangentially and topic maintenance (Coelho, 2007; Stein & Glenn, 1979). The use of super-structural measures has mainly occurred in the context of narrative discourse (Gillam, Gillam, Fargo, Olszewski, & Segura, 2016). As the CUDP-A samples four monologic genres, a set of codes were generated to reflect the genre of each structure. This was guided by the broader narrative literature (e.g. Stein & Glenn, 1979) and resources on written discourse including Australian curriculum guidelines and empirical studies (Coelho, 2007; Whitworth et al., 2015).

For personal recount and fictional narratives, schemata aligned to traditional story grammar (Stein & Glenn, 1979). This consisted of an orientation to setting and characters, initiating event, character response, plan, and attempt, outcome or resolution, and ending (Stein & Glenn, 1979). The expository framework was developed by synthesising curricula and assessment outlines published by Western Australia's School Curriculum and Standards Authority (SCSA) and educational materials relevant to non-fiction text writing (Harvey, 1998; School Curriculum and Standards Authority, 2017; SCSA, 2016). This included opening utterances introducing and defining the topic of attention, followed by the body of output explaining various aspects of the topic (Harvey, 1998; SCSA, 2016; 2017). This may include further description of the characteristics or attributes and examples of the issue, a series of cause and effect statements, and/or a comment on problem/solution followed by concluding statements (Harvey, 1998). The super-structural measures obtained in this study included tallies of schema elements within each genre and occurrences of incorrect ordering of information. For persuasive discourse, the presence and order of key components were defined using the ACARA marking criteria for the National Assessment Program of Literacy and Numeracy (NAPLAN) persuasive writing component (ACARA, 2017). This included a thesis statement followed by supporting / counter arguments, relevant evidence, and concluding statements (ACARA, 2017). A set of general codes was developed in order to measure the degree of adherence to defined schemata. These codes included the frequency of schema deviations, order deviations, genre shifts, and restatements of question. As these additional codes were developed for this thesis, they are exploratory in nature. This should be considered when interpreting the results of this thesis. The occurrence of each genre-specific component and general code was tallied for each participant.

Assessment of General Oral Language

The CELF-4 (Semel et al., 2003) was administered to assess receptive and expressive language skills. The CELF-4 is considered a 'gold standard' assessment of oral language in children and young adults (Paslawski, 2005) and provides US-based norms from sample of 2,650 children, adolescents, and young adults (ages 5 to 21; Semel et al., 2003). The CELF-4 is associated with good internal consistency for subtests (α = .69 to .91) and composite scores (α = .87 to .95), test re-rest reliability for subtests (r= .71 to .92) and composites (r= .87 to .95), and inter-rater agreement (88% to 99%) on subtests that required clinical judgment and interpretation (Semel et al., 2003). A Core Language Score (CLS) was calculated as an index of oral language skills for each participant. The CLS was derived from the sum of the scale scores of four subtests; Concepts and Following Directions (completely by participants 12; 0 to 12;11 only), Recalling Sentences, Formulated Sentences, Word Classes, and Word Definitions (completed by participants 13;0 – 15;11 only) (Semel et al., 2003). Administration time for the CELF-4 was 30 minutes.

Assessments of Cognitive Function

To examine the relationship between discourse and cognitive function, a battery of cognitive assessments was administered. The choice of cognitive constructs and assessment tools was informed by the systematic review presented in Chapter 2 (Hill et al., 2018). All tasks where chosen based on their recommendation for use in clinical practice and empirical research in paediatric ABI (Hicks et al., 2013; Miller et al., 2012; Wilde et al., 2010). The battery of cognitive assessments has been previously described in Chapter 6 (page 144).

Assessments of Psychosocial health

The psychosocial constructs assessed in Part Three of this thesis included HRQoL, daily participation, family function, and perceived communication competence. These factors were chosen to align with constructs included within MacDonald's (2017) model of cognitive-communication (see Figure 1). The psychosocial assessments administered Study 5 of the research program have been previously outlined in Chapter 6 (see page 149).

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MacDonald 2017.CCC Model_ (002).jpg
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Sheila

Sheila MacDonald M.Cl.Sc. SLP (C) Reg.CASLPO
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To Lizz Hill

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Elizabeth Hill, Mary Claessen, Anne Whitworth & Mark Boyes (2020) Profiling variability and development of spoken discourse in mainstream adolescents, Clinical Linguistics & Phonetics, DOI: 10.1080/02699206.2020.1731607

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Appendix D Chapter 2 Appendices

Appendix D.1 Medline Search Strategy (11th September 2017)

1. Brain Injury, Chronic/co, di, et, pa, pp, px, rh, th
2. "brain injur*".mp.
3. "ABI".mp.
4. "TBI".mp.
5. Head Injuries, Closed/co, di, et, pa, pp, px, rh, th
6. Head Injuries, Penetrating/co, di, et, pa, pp, px,

rh, th

7. "head injur*".mp.
8. "CHI".mp.
9. Cognition/
10. "cognitive function*".mp.
11. "cognitive process*".mp.
12. Executive function/
13. "executive function*".mp.
14. Attention/
15. "attention".mp.
16. memory, short-term/
17. memory, long-term/
18. "short term memory".mp.
19. "long term memory".mp.
20. "working memory".mp.
21. "Theory of Mind"/
22. "theory of mind".mp.
23. Language/
24. "language".mp.
25. "discourse".mp.
26. "communication".mp.
27. Verbal behavior/
28. "verbal behavio?r".mp.
29. Narration/
30. "narrative*".mp.
31. "cognitive communication".mp.
32. 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8
33. 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16 or 17 or 18 or 19 or 20 or 21 or 22
34. 23 or 24 or 25 or 26 or 27 or 28 or 29 or 30 or 31
35. 32 and 33 and 34
36. limit 35 to (english language and humans)

a. Medline auto peer-reviewed

b. Nil age limiters

Appendix D.2 Formal Tools and Outcome Measures

Function	Test	Stand'd	Norms	Outcome measure(s)	Studies
Cognitive (N)					
General (3)	Neuro-behavioural Rating Scale – Revised (Levin, Mazaux & Vanier, 1990)	✓	x	Domain score(s) & overall score	Rousseaux et al. (2010)
	Montreal Cognitive Assessment (Nasreddine et al., 2005)	✓	✓	As above	LeBlanc et al. (2014)
	Functional Independence Measure – Cognitive component (Keith et al., 1987)	✓	✓	Domain score	Hammond et al. (2004)
Executive function					
Broad indices (7)	Wisconsin Card Sorting Test (WCST; Heaton et al., 1993)	✓	✓	%Conceptual responses	Brookshire et al. (2000)
				%/Total pers. responses	Coelho et al. (1995); Coelho et al. (2002)
				%/Total pers. errors	Coelho et al. (1995); Coelho (2002); Galetto et al. (2013); Marini et al. (2011); Marini et al. (2014); Marini et al. (2017); Zimmermann et al. (2011).
				%/Total non-pers errors	Galetto et al. (2013); Marini et al. (2011); Marini et al. (2014); Zimmermann et al. (2011)
				Total categories	Coelho et al. (2002); Marini et al. (2017); Zimmermann et al. (2011);
				Total ruptures	Zimmermann et al. (2011)
	Delis-Kaplan Executive Function System – Card Sort (D-KEFS; Delis, Kaplan & Kramer, 2001)	✓	✓	Scale score	Coelho et al. (2013); Le et al. (2012); Le et al. (2014)
				M Card sort score	Mozeiko et al. (2011)
	Delis-Kaplan Executive Function System– Tower Test	✓	✓	Total achievement score	Mozeiko et al. (2011)
	Behavioural Assessment of Dysexecutive Syndrome – Key Search, Temporal Judgment, Rule Shift (BADS; Wilson, Alderman, Burgess, Emslie & Evans, 1996)	✓	✓	Subscale scores	Matsuoka et al. (2012)
	Brazillian Brief Neuropsychological Assessment Battery – Problem Solving (NEUPSILIN; Fonseca, Salles, & Parente, 2009)	✓	✓	Total score	Zimmerman et al. (2011)
	Detroit Tests of Learning Aptitude – Likeness and Differences (DTLA; Baker & Leland, 1967)	✓	✓	Total score	Peach (2013)
	Tower of London (Shallice, 1982)	x	✓	%correct	Brookshire et al. (2000)

Function	Test	Stand'd	Norms	Outcome measure(s)	Studies
	Trail-Making Test (Reitan, 1958)	✓	✓	Total time	Galetto et al. (2013); Hammond et al. (2004); Peach (2013); Snow et al. (1998); Marini et al. (2011); Marini et al (2014); Marini et al. (2017); McDonald et al (2014); Zimmermann et al. (2011)
				Time A – B	Rousseaux et al. (2010); Zimmermann et al. (2011)
				TMT B/A; TMT B-A/A; Accuracy score	Zimmermann et al. (2011)
Verbal Fluency (4)	Controlled Oral Word Association Test (Benton, Hamsher & Sivan, 1994)	✓	✓	As above	McDonald et al. (2014)
	Neurosensory Center Comprehensive Examination for Aphasia – Sentence Repetition; Word Fluency (Spreen & Benton, 1977)	✓	✓	As above	Sentence Repetition: Peach (2013) Word Fluency: Peach (2013); Snow et al. (1998)
	Semantic / Phonenmic Fluency	x	✓	As above	Marini et al. (2014); Rousseaux et al. (2010)
	Fluency Test (Benton & Hamsher, 1976)	✓	✓	As above	Brookshire et al. (2000)
Inhibition (2)	Go-no-Go Task (Drewe, 1975)	✓	x	Reaction time	Brookshire et al. (2000)
	Hayling's Sentence Completion Test (Burgess & Shallice, 1997)	✓	✓	Access time and total correct	Zimmermann et al. (2011)
Updating (1)	N-back task	✓	✓	%net responses	Chapman et al. (2006)
Working Memory (4)	Non-word repetition task (Dolloghan & Campbell, 1998)	✓	✓	%phonemes correct	Hay & Moran (2005)
	Competing Language Processing Task (CLPT; Gaulin & Campbell, 1994)	✓	x	%words recalled	Hay & Moran (2005); Moran et al (2012)
	Wechsler Memory Scale (WMS), WMS-Revised, WMS-III	✓	✓	Scale scores	Coelho et al. (2012); Coelho et al. (2013); Le et al. (2012); Le et al. (2014); LeBlanc et a. (2014); Hartley & Jensen (1991); Matsuoka et al. (2012); McDonald et al. (2014); Peach (2013); Youse & Coelho (2005).
	NEUPSILIN – Ascendant Ordering of Digits, Oral Word Span	✓	✓	Total span score	Zimmermann et al. (2011)
Attention (2)	Divided Attention Test (Hiscock et al., 1987)	x	x	Total time	Brookshire et al. (2000)
	Stroop Task (Stroop, 1935)	✓	✓	Total errors	Rousseaux et al. (2010)
Memory (5)	WMS, WMS-R, WMS-III Immediate Memory; Logical Memory; Digits Forward; Orientation (see above)	✓	✓	Index scores	Coelho et al. (2013); Le et al. (2012); Le et al. (2014)
				Scale scores	Hartley & Jensen (1991); Matsuoka et al. (2012); McDonald et al. (2014); Peach (2013); Youse & Coelho (2005)
	California Verbal Learning Test (Delis et al., 1986)	✓	✓	Total score / cluster score	Brookshire et al. (2000)

Function	Test	Stand'd	Norms	Outcome measure(s)	Studies
	Phonological digit span forward	x	x	Total words	Marini et al. (2011)
	Rey's Auditory Verbal Learning Test (RAVLT; Schmidt, 1996)	✓	✓	As above	Galetto et al. (2013); Hammond et al. (2014); Marini et al. (2011); Marini et al. (2014); Marini et al. (2017); Snow et al. (1998)
	Hopkins Verbal Learning Test (Brandt, 1991) (episodic verbal memory)	✓	✓	As above	Hammond et al. (2004)
Processing speed (5)	Rapid Automatic Naming (RAN; Denckla & Rudel, 1974)	✓	✓	Total time	Brookshire et al. (2000)
	Semantic memory verification speed (Baddeley & Wilson, 1988)	x	x	As above	Brookshire et al. (2000)
	Wechsler Intelligence Scale for Children – Revised, Coding (WISC-R; Wechsler, 1974)	✓	✓	As above	Brookshire et al. (2000)
	Speed and Capacity of Language Processing Test – Speed of Comprehension (SCOLP; Baddeley, Emslie & Smith, 1992)	✓	✓	As above	Snow et al. (1998)
	Symbol Digit Modalities Test (SDMT; Smith, 2007)	✓	✓	Total correct	Hammond et al. (2004)
ToM / Social Inference (3)	The Awareness of Social Inference Test (TASIT; McDonald, Flanagan, Rollins & Kinch, 2003)	✓	✓	Total score	McDonald et al. (2014)
	Reading the Mind in the Eyes Test (RMET; Baron-Cohen, Wheelwright, Hill, Raste & Plumb, 2001)	✓	✓	As above	McDonald et al. (2014)
	Interpersonal Reactivity Index (IRI; Davis, 1980)	✓	✓	As above	McDonald et al. (2014)
IQ (4)	Wechsler Adult Intelligence Scale (Wechsler, 1992)	✓		As above	Coelho et al. (2013); Le et al (2014); Hammond et al. (2004); McDonald et al. (2014) *
	Raven's Coloured Progressive Matrices (Raven, 1998)	✓	✓	Total abbreviated score	Peach (2013)
	Wechsler Test of Adult Reading (Wechsler; 2001)	✓	✓	As above	McDonald et al. (2014)
	Porteus Maze Learning (Porteus, 1965)	✓	✓	As above	Brookshire et al. (2000)
Discourse					
General communication (3)	Functional Independence Measure – Cognitive Comprehension/Expression subtest	✓	x	Total score	Hammond et al. (2004)
	Lille Communication Test (LCT)	✓	x	Verbal communication global and subscale scores	Rousseaux et al. (2010)
	Montreal Protocol for the Evaluation of Communication (D-MEC)	✓	✓	Total and subscale scores	LeBlanc et al., 2014; Zimmermann et al., 2011),

Appendix D.3 Group Differences on Cognitive Measures

Construct	Assessment (outcome measure)	ABI-related deficit †	Study
Neuro-behavioural functioning	NRS-R (domain & overall scores)	Yes	Rousseauxet al. (2010)
Executive function			
General	TMT (B-A)	Yes	Rousseauxet al. (2010)
	WCST (perseverative errors)	Yes	Marini et al. (2011); Marini et al. (2014); Marini et al. (2017)[a]
		No	Galetto et al. (2013)
	WCST (non-perseverative errors)	Yes	Galetto et al. (2013); Marini et al. (2011); Marini et al. (2014)
	WCST (categories)	Yes	Marini et al. (2017)[a]
	WCST (%conceptual responses)	No	Brookshire et al. (2000)
	Tower of London (%correct)	No	Brookshire et al. (2000)
	D-KEFS Card Sort (total score)	No	Coelho et al. (2013)
	D-KEFS Tower Test (total achievement)	No	Mozeiko et al. (2011)
	D-KEFS Card Sort (total score)	No	Mozeiko et al. (2011)
Verbal fluency	Fluency Test (total accurate)	Yes	Brookshire et al. (2000)[b]
	COWAT (total accurate)	Yes	McDonald et al. (2014)
	Semantic fluency (total accurate)	Yes	Marini et al. (2011); Rousseauxet al. (2010)
	Semantic fluency (total accurate)	No	Galetto et al. (2013); Marini et al. (2011); Marini et al. (2014)
	Phonemic fluency (total accurate)	No	Galetto et al. (2013); Marini et al. (2011); Marini et al. (2014)
Inhibitory control	Hayling's (SS)	Yes	McDonald et al. (2014)
	Hayling's B(total time)		
	Go-no-Go Task (reaction time)	No	Brookshire et al. (2000)*
	Hayling's A/B (total errors & B-A)		
Updating	Letter identity n-back (net score)	Yes	Chapman et al. (2006)*
	Letter rhyme n-back (net score)	No	Chapman et al. (2006)*
Working memory	WMS-III Spatial-span Backward (SS) and WM index	Yes	Coelho et al. (2012)
	WMS-III Digits Backward (SS)	Yes	Coelho et al. (2013)
	Non-word Repetition Task (%phonemes correct)	Yes	Hartley & Jensen (1991)
	CLPT (%words recalled)	Yes	Hay & Moran (2005)
	Phonological STM backward (total recalled)		
	CLPT (%words recalled)	Yes	Marini et al. (2011)
		Yes	Moran et al. (2012)

Construct	Assessment (outcome measure)	ABI-related deficit †	Study
	WMS-III Letter-number Sequencing (SS)	No	Coelho et al. (2012)
Attention			
Sustained	All TMT-A (total time)	Yes	Marini et al. (2011); McDonald et al. (2014)*
	TMT-A (total time)	No	Galetto et al. (2013); Marini et al. (2014)
Selective	TMT-B (total time)	Yes	Marini et al. (2011); Marini et al. (2017)[a]; McDonald et al. (2014)
		No	Galetto et al. (2013); Marini et al. (2014)
	Stroop task (total errors)	Yes	Rousseaux et al. (2010)
Divided	Divided Attention Test (total time)	Yes	Brookshire et al. (2000) [b]
Memory	CLVT (total and cluster scores)	Yes	Brookshire et al. (2000) [b]
		No	Chapman et al. (2006)
	WMS-III (IM index)	Yes	Coelho et al. (2013)
	WMS-III Digits Forward (SS)	Yes	Galetto et al. (2013)
	Phonological STM forward (total recalled)		
	WAIS-III Digit Span (SS)	Yes	Marini et al. (2011)
	WMS-III Logical Memory (SS)	Yes	Hartley & Jensen (1991); McDonald et al. (2014)
	CLVT (total score)	No	Chapman et al. (2006)
	RAVLT Immediate (total words)	Yes	Marini et al. (2011); Marini et al. (2017)[a]
		No	Galetto et al. (2013); Marini et al. (2014)
	RAVLT Delayed (total words)	Yes	Galetto et al. (2013); Marini et al. (2011); Marini et al. (2017)[a]
Processing speed	RAN; Semantic Memory Verification Speed; WISC-R coding (all total time)	No	Brookshire et al. (2000)
ToM / Social inference	TASIT; RMET; IRI (all total score)	Yes	McDonald et al. (2014)
Intelligence	WAIS-III (total score)	Yes	Coelho et al. (2013)
	WTAR (SS)	Yes	McDonald et al. (2014)
	Porteus Mazes (total score)	No	Brookshire et al. (2000) [*]

Note: [*] categorised as per test information; Effect of [a] injury severity, [b] time since injury, † as indicated by significantly impaired performance in participants with ABI relative to controls, or in participants with less severe injuries relative to those with greater severity.

Appendix D.4 Group Differences on Discourse Measures

Feature	Outcome measure	ABI-related deficit†	Study
Micro-linguistic			
Productivity	Total communication units	Yes	Coelho et al. (2013); Hartley & Jensen (1991)[c]; Hay & Moran (2005)[c]; Marini et al. (2011)
		No	Brookshire et al. (2000); Hartley & Jensen (1991)[c]; Matsuoka et al. (2012); Moran et al. (2012); Peach (2013); Snow et al. (1998)
	Total words	Yes	Brookshire et al. (2000)[b]; Hartley & Jensen (1991)[c] ; Hay & Moran (2005)[c]
		No	Galetto et al. (2013); Marini et al. (2011); Moran et al. (2012)
	Mean Length of Utterance	No	Galetto et al. (2013); Peach (2013)
	Words / c-unit	Yes	Hartley & Jensen (1991)[c]; Coelho (2002)[c]
		No	Hartley & Jensen (1991)[c]
	Speech rate	Yes	Galetto et al. (2013); Hartley & Jensen (1991); LeBlanc et al. (2014)[a]; Marini et al. (2011); Marini et al. (2014); Marini et al. (2017)
	Sample duration	Yes	Matsuoka et al. (2012)
		Yes	Hartley & Jensen (1991)[c]
		No	Hartley & Jensen (1991)[c] ;Snow et al. (1998)
	Pauses between/within c-units	Yes	Peach (2013)
Lexical diversity	Lexical diversity	Yes	Hay & Moran (2005)
Syntax	Clause type / total	No	Moran et al. (2012)
	Clauses per t-unit	Yes	Brookshire et al. (2000)[b d]; Hay & Moran (2005)[c]
		No	Coelho (2002)[c]; Coelho et al. (2012); Coelho et al. (2013)
	Clausal density	No	Moran et al. (2012)

Feature	Outcome measure	ABI-related deficit†	Study
	%Paragrammatic errors	Yes	Marini et al. (2011)
		No	Galetto et al. (2013)
	%Complete sentences	Yes	Marini et al. (2017) [a]
		No	Galetto et al. (2013); Marini et al. (2011)
	LCT score	No	Rousseaux et al. (2010)
Maze analysis	Total mazes	Yes	Moran et al. (2012)
	Mazes per utterance	Yes	Peach (2013)
	%Syllables in mazes	Yes	Hartley & Jensen (1991)
	Abandoned utterances	No	Peach (2013)
Intelligibility	LCT score	Yes	Rousseaux et al. (2010)
Word-level errors	Phonological paraphasias	Yes	Marini et al. (2011); Marini et al. (2014)
		No	Marini et al. (2014); Marini et al. (2017); Peach (2013)
	LCT score	Yes	Rousseaux et al. (2010)[d]
		No	As above
	%Phonological selection	No	Galetto et al. (2013); Marini et al. (2011)
	%Semantic paraphasias	No	Galetto et al. (2013); Marini et al. (2011); Marini et al. (2017)
	Frequency of anomia/ omissions	No	Peach (2013); Rousseaux et al. (2010)
	Subject-verb agreement	No	Peach (2013)
	D-MEC Score	Yes	LeBlanc et al. (2014)[a]
	%Lexical Informativeness	Yes	Galetto et al. (2013); Marini et al. (2011); Marini et al. (2014)
Micro-structural			

Feature	Outcome measure	ABI-related deficit†	Study
Cohesion	Total problems of reference	Yes	Hartley & Jensen (1991)[c]
		No	As above [c]
	Total cohesive tie type	Yes	Hartley & Jensen (1991)[c]
		No	As above [c]
Cohesive adequacy	%Complete ties of total ties	No	Coelho (2002)[c e]; Coelho et al. (2012); Coelho et al. (2013)
	%Cohesive errors	Yes	Marini et al. (2011)
	Cohesion rating	Yes	Chapman et al. (2006)[a]
Macro-structural			
Coherence	Local coherence score	Yes	Chapman et al. (2006)[a]; Marini et al. (2014); Rousseaux et al. (2010)
		No	Coelho et al. (2012); Coelho et al. (2013);
	Global coherence score	Yes	Chapman et al. (2006)[a]; Coelho et al. (2012)[f]; Marini et al. (2011); Marini et al. (2014); Rousseaux et al. (2010)
		No	Coelho et al. (2013)
	%Global coherence errors	Yes	Galetto et al. (2013); Marini et al. (2011); Marini et al. (2017)
	%Local coherence errors	Yes	Marini et al. (2017)
		No	Galetto et al. (2013)
	D-MEC score	Yes	LeBlanc et al. (2014)[a]
Relevance	Total CIUs	No	Matsuoka et al. (2012)
	%Lexical informativeness	Yes	Galetto et al. (2013); Marini et al. (2011); Marini et al. (2017) [a]
	CDA-M score	Yes	Snow et al. (1998)
Efficiency	Units per time	Yes	Matsuoka et al. (2012)

Feature	Outcome measure	ABI-related deficit†	Study
	CIUs per time	Yes	As above
	CIUs per unit	No	As above
	Ratio of thematic density	Yes	Marini et al. (2011)
	%Thematic Informativeness	Yes	Marini et al. (2017) [a]
		No	Galetto et al. (2013); Marini et al. (2011); Marini et al. (2014)
Super-structural			
Organisation	T-units within episode structure	Yes	Coelho (2002)[c]; Coelho et al. (2013); Mozeiko et al. (2011); Rousseaux et al. (2010)
		No	Coelho et al. (2012)
	Total episodes or propositions	Yes	Brookshire et al. (2000)[a b d];Hay & Moran (2005)[c]; Moran et al.(2012); Mozeiko et al. (2011).
		No	Coelho (2002)[c]
	Completeness / Intactness score	Yes	Hay & Moran (2005)[c]
		No	Marini et al. (2014)
	D-MEC score	Yes	LeBlanc et al. (2014) [a]
	Total critical components	Yes	Coelho et al. (2012)[f]; Coelho et al. (2013); Hartley & Jensen (1991);Hay & Moran (2005)[c]
	Total inaccurate content units	Yes	Hartley & Jensen (1991)[c]
	Total correct details	Yes	McDonald et al. (2014)
	CDA-M score	Yes	Snow et al. (1998)
	LCT score	Yes	Rousseaux et al. (2010)
	%Filler utterances	No	Marini et al. (2017)
Topic	Total tangential utterances	Yes	Marini et al. (2017); Moran et al. (2012)

Feature	Outcome measure	ABI-related deficit†	Study
	LCT score	Yes	Rousseaux et al. (2010)
	D-MEC Score (topic shifts)	No	LeBlanc et al. (2014)
	D-MEC Score (repetitiveness)	Yes	LeBlanc et al. (2014) [a]
	%Repeated utterances	Yes	Marini et al. (2017) [a]
	%Incongruent utterances	No	Marini et al. (2017)
	CDA-M Score	No	Snow et al. (1998)
Verbal communication	D-MEC Total score	Yes	LeBlanc et al. (2014) [a]
	LCT Verbal Communication score	Yes	Rousseaux et al. (2010)

Appendix D.5 Quality Ratings (QualSyst) by study

	Study #														
Criteria	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Question / objective	1	1	1	2	2	1	2	1	2	1	2	1	1	2	2
Study design	2	2	2	2	2	2	2	2	2	2	2	2	0	2	2
Method of subject/comparison group selection	1	1	1	1	1	1	1	1	1	1	1	0	1	0	1
Subject (and comparison group, if applicable) characteristics	2	1	2	1	1	1	1	1	2	1	1	1	1	2	2
Outcome and (if applicable) exposure measure(s)	1	1	2	1	2	2	2	2	2	2	2	2	2	2	2
Sample size	1	2	1	1	1	2	1	1	2	1	1	1	1	1	1
Analytic methods	1	2	1	2	1	2	2	2	2	2	2	2	1	2	2
Estimate of variance	2	0	2	2	2	2	2	0	2	1	2	2	0	2	2
Controlled for confounding	0	0	2	2	1	2	2	0	1	1	1	1	1	2	1
Results	1	1	2	2	2	2	2	2	2	2	1	2	1	2	2
Conclusions supported	2	2	2	2	2	2	2	2	2	2	2	1	1	2	2
Total score	63.6	59.1	81.8	81.8	77.3	86.4	77.3	63.6	90.9	72.7	77.3	68.2	45.5	86.4	86.4

Criteria	Study #									
	16	17	18	19	20	21	22	23	24	25
Question / objective	2	2	1	0	2	2	2	2	2	1
Study design	2	2	2	2	2	2	2	2	2	2
Method of subject/comparison group selection	2	2	1	1	1	2	2	1	2	1
Subject (and comparison group, if applicable) characteristics	2	1	2	1	1	1	2	1	2	1
Outcome and (if applicable) exposure measure(s)	2	1	2	2	1	2	1	2	2	2
Sample size	1	1	2	1	1	2	2	1	1	2
Analytic methods	1	1	2	1	1	2	2	2	1	2
Estimate of variance	1	2	2	2	1	2	2	2	2	2
Controlled for confounding	2	0	2	1	1	2	1	1	2	2
Results	2	2	2	2	2	1	2	2	2	1
Conclusions supported	2	2	2	2	2	2	2	2	2	1
Total score	86.4	72.7	90.9	68.2	68.2	90.9	90.9	81.8	86.4	68.2

Appendix E Sample Recruitment Materials and Assessment Report

Appendix E.1 Example Curtin HREC-approved Information Letters and Consent Forms for Recruitment of Adolescent Reference Sample

Spoken Discourse in Adolescents

Parent Information and Consent Form

Dear Parent,

My name is Elizabeth Hill and I am a Speech Pathologist and PhD student at Curtin University. I am researching the communication skills of teenagers in everyday situations. This includes telling a story, having a conversation with friends or explaining how to play a game.

I am also looking into how communication skills impact the activities that teenagers take part in, and how they interact with friends and family. The results of this project will help speech pathologists plan effective treatment for teenagers with communication difficulties. I am currently seeking teenagers between 12 and 15 years old to take part in this research project. Your child can be involved if they speak English as a first language, and they do not have Autism Spectrum Disorder or intellectual disability or disorder.

What does participation in the research project involve and are there any risks?

If you give permission for your child to participate in this study, I will assess your child's communication, attention, and memory skills. I will also ask you and your child to complete some questionnaires about your child's daily activities, their emotions, and your family communication. These questionnaires will be completed either in person, over the phone, or online; I will send you the URL via email.

The assessment will take approximately two (2) hours, but will be spread over two 45-60 minute sessions. These sessions will take place at a location and time that is convenient for you and your child, whether that be at your home or at Curtin University.

To achieve the aims of this project, the assessment sessions will cover language, executive function (attention), memory, and daily activities at school and in the home. Some of the tasks will be audio-recorded, so that the Speech Pathologist can score your child's performance at a later date. Specific details about each assessment, including the purpose of each task, can be found on the sheet entitled *"Parent Information Sheet: Assessment Details";* attached to this form. Each assessment task will be given by a speech pathologist who is currently undertaking a PhD at Curtin University and who is trained in administering these assessment tasks.

There are no foreseeable risks or side effects associated with participation in this project. There is a possibility that assessment results may indicate that the presence of difficulties within language or communication, memory, executive function (attention), and emotional wellbeing. If your child's performance indicates that he/she may be having difficulties, the results will be discussed with you and your child in detail.

You will receive **a movie voucher** to thank you for your time.

Does my child have to take part?

Participation in this project is entirely voluntary. Your child does not have to take part if you do not wish them to. If you would like your child to take part, I have included a consent form for you to sign. I have also included a consent form for your child. Please talk to your child about the activities and let them know that they do not need to take part if they do not want to.

What if either of us was to change our mind?

If you give permission, but then change your mind, you may withdraw your child, or your child may withdraw themselves, at any time without consequence. If your child is withdrawn from the study, all of your child's information will be destroyed immediately.

What will happen to the information collected, and is privacy and confidentiality assured?

When information is collected, his/her name and any personal information will be removed and a code will be given instead. Your child's information is stored this way so that, if you decide to take part and then withdraw from the project, we can find your child's information and destroy it.

You have the option to receive a summary of your child's performance on standardised assessments of language, executive function, and memory (see checklist attached to this letter). You will receive your child's performance on assessments of emotional and social well-being, if their results indicate they may be at risk of difficulties.

The results of this project may be published, but no personal information about your child will be used. The results may be published in Journals that publish research on the areas covered in this research project. If you would like to access the findings of this research, a member of the research team would be happy to direct you to the published results.

Your child's name or details will not be given to anyone. However, this information may be provided in a situation where the research team must legally report this information, according to the Department of Education Child Protection Policy.

The hardcopy assessment record forms and audio-files will be stored in a secure filing cabinet at Curtin University and only specific staff involved in this project will have access. The audio recordings of your child will only be used as part of the assessments for this study. Records will be kept for 7 years or until the child reaches 25 years of age, whichever is later, and then destroyed.

What are the benefits of this research for my child?

Your child will receive a detailed assessment of their language and executive and memory skills as part of this project. You will be provided with a report of your child's performance across language, executive function, and memory if you elect to do so.

How do I know that the people involved in this research have all the appropriate documentation to

be working with children?

Under the Working with Children (Criminal Record Checking) Act 2004, researchers that work with children must pass a Working with Children Check. I will provide you with a copy of my Working with Children check at the beginning of the first assessment session.

Is this research approved?

Approval has been received from the Curtin University Human Research Ethics Committee (HRE2016-0219). Any questions or verification of approval for this study can be obtained by contacting the Committee.
Address: Curtin University Human Research Ethics Committee, c/- Office of Research and Development, Curtin University, GPO Box U1987, Perth, 6845.
Telephone: 9266 9223
Email: hrec@curtin.edu.au

What if I have further questions about this research project?

Please do not hesitate to contact me or any member of the research team if you have any questions about the project. I can be contacted by email at Elizabeth.j.hill@postgrad.curtin.edu.au. You may also wish to contact members of the research team, Dr. Mary Claessen (m.claessen@curtin.edu.au) or 9266 3472, Associate Professor Anne Whitworth (anne.whitworth@curtin.edu.au) and Dr. Mark Boyes (mark.boyes@curtin.edu.au).

How do I indicate my willingness for my child to be involved in this project?

If you have read the above information carefully and have had all questions about the research project answered to your satisfaction, and are willing for your child to participate, please complete the **Consent Form** attached. Please send the completed form electronically to elizabeth.j.hill@postgrad.curtin.edu.au OR send by post to:

Elizabeth Hill
School of Occupational Therapy, Social Work, and Speech Pathology
Curtin University
GPO Box U 1987, Perth
Western Australia, 6845

Thank you,
Regards,

Elizabeth Hill	Dr Mary Claessen	Ass Pro Anne Whitworth
Speech Pathologist	Speech Pathologist	Speech Pathologist
PhD Candidate	Supervisor /Senior Lecturer	Supervisor/Assoc Professor
Curtin University	Curtin University	Curtin University

Dr Mark Boyes	Professor Pete McEvoy
Psychologist	Senior Clinical Psychologist
Supervisor & Research Fellow	Curtin University
Curtin University	

This study has been approved by the Curtin University Human Research Ethics Committee (Approval Number HRE2016-0219*). The committee is comprised of members of the public, academics, lawyers, doctors and pastoral carers. If needed, verification of approval for this study can be obtained by contacting the Committee: Curtin University Human Research Ethics Committee, c/- Office of Research and Development, Curtin University, GPO Box U1987, Perth, 6845. Telephone: 9266 9223, Email: hrec@curtin.edu.*

School of Occupational Therapy, Social Work, and Speech Pathology
Curtin University
GPO Box U 1987, Perth Western Australia, 6845

Spoken Discourse in Adolescents

Parent Consent Form

| | I have read this document and I understand the aims, procedures, and risks of this project.
| | I have been given the opportunity to ask any questions, and these have been answered.
| | I am willing for my child to become involved in the research project, as described.
| | I have talked to my child about the project, and he/she wishes to take part, as indicated by his/her completion of the child consent form.
| | I understand that participation in this project is completely voluntary.
| | I understand that both my child and I are free to withdraw from participation at any time without consequence
| | I give permission for the contribution that my child makes to this research to be used in conference talks and published in a journal, provided that my child is not identified in any way.
| | I understand that a summary of findings from the research can be made available to me and my child upon its completion.
| | I understand that my child's responses on language, cognitive and daily life tasks will be audio recorded to allow scoring and further analysis to take place.
| | I understand that I may be contacted via phone and email at a time convenient to me to complete questionnaires as part of my involvement in this project.

Please also tick this box to give permission for:

| | I would like to be provided with a summary of my child's (please provide your address).

____

Name of Child (please print): ____
Date of birth (please print): _____/ _____/ ________
Name of Parent (please print): ____
Phone (parent): ____
Email (parent): ____
Signature of Parent/Carer: ____
Date (DD/MM/YYYY): _____/ _____/ ________

School of Occupational Therapy, Social Work, and Speech Pathology
Curtin University
GPO Box U 1987, Perth

Spoken Discourse in Adolescents

Participant Consent Form

Dear Student,

My name is Elizabeth Hill and I am a Speech Pathologist and student at Curtin University. I am interested the different ways adolescents, between 12 and 15 years old, communicate across everyday situations with friends and family. For example, telling a story, having a conversation with friends, or explaining how to play a game.

I am also interested to see if the way teenagers communicate impacts the activities they take part in and how well they take part in these activities.
In this project, I would like to see how you communicate across different tasks like telling a story or giving your opinion to a friend, and how your communication impacts the things you do every day. When this study is finished, I hope it will help Speech Pathologists who work with people your age to improve the way they communicate with friends and family.

Do I have to be in this study?

You do not have to participate in this study. It is up to you. You can say no now or you can even change your mind later. No one will be upset with you if you decide not to be in this study. Your marks at school and your relationships with parent and teachers will not change if you decide you do not want to take part OR if you choose to stop at any time.

What we are asking you to do:

If you choose to be involved in this project, you will see a Speech Pathologist for two sessions. These sessions will last for 60 minutes, and will involve a variety of tasks. These tasks have been carefully chosen, so they cover the areas of your language and communication, executive functioning, and memory, as well as your participation in daily social, academic, and physical activities. Some tasks will require a lot of talking, others involve puzzles and answering number- and word-based questions. I will need to audio-record some of the tasks, so that I can listen to your answers at a later time.

We can do these tasks at a place and time that is convenient to you and your parent(s), e.g. at home, or at school. If you want to do these tasks at school, I will discuss the best time with your teacher(s). You will be given **a movie voucher** to thank you for your time.

Will being in this study hurt or help me in any way?

Taking part in this project will not hurt you in any way. You will probably find most of the tasks and activities quite interesting, and you will be helping speech pathologists better understand how and why teenagers communicate.

I hope this study will help Speech Pathologists design useful treatments to help teenagers who have difficulty communicating. If these tasks reveal any cause for concern, we will look into your results further, and discuss how we can help you.

If you want to stop doing the study, email me at elizabeth.j.hill@postgrad.curtin.edu.au or call my supervisor, Mary, on 9266 3472. If you decide to stop coming to sessions before I have finished the study, all the information you have given me will be destroyed. There is no punishment for deciding to stop doing the study. If you decide that you don't want your information in the study after I have finished, just let me know and contact me on the above number and email address.

What will you do with information about me?

I will be very careful to keep your answers and tape recording private. Before and after the study I will keep all information, I collect locked up and password protected at my University. When other people look at my study they will not know which information is yours. Your parents may be provided with a summary of how you have gone on the language and executive function/memory tasks. Your results on the measures of social and emotional well-being will only be given to your parent(s) if they indicate you are having some difficulty.

If you have questions about the study, contact any member of the research team:

Elizabeth Hill – Elizabeth.j.hill@postgrad.curtin.edu.au (Speech pathologist and PhD student)
Dr. Mary Claessen – m.claessen@curtin.edu.au (Speech pathologist and supervisor)
Associate Professor Anne Whitworth – anne.whitworth@curtin.edu.au (Speech pathologist and supervisor) or Dr. Mark Boyes – mark.boyes@curtin.edu.au (Psychologist and supervisor)

Agreement:

By signing this form, I agree to be in the research study described above (you will receive a copy of this form).

Name: ____

Signature: ____ **Date:** ____________

Kind regards,
Elizabeth Hill
Speech Pathology PhD Student
School of Occupational Therapy, Social Work, and Speech Pathology
Curtin University
GPO Box U 1987, Perth
Western Australia, 6845

This study has been approved by the Curtin University Human Research Ethics Committee (Approval Number HRE2016-0219*). The committee is comprised of members of the public, academics, lawyers, doctors and pastoral carers. If needed, verification of approval for this study can be obtained by contacting the Committee: Curtin University Human Research Ethics Committee, c/- Office of Research and Development, Curtin University, GPO Box U1987, Perth, 6845. Telephone: 9266 9223, Email: hrec@curtin.edu.au.*

School of Occupational Therapy, Social Work, and Speech Pathology

Curtin University

GPO Box U 1987, Perth Western Australia, 6845

Spoken Discourse in Adolescents

Parent and Participant Assessment Information Sheet

This sheet provides information about each assessment that you or your child will complete if you choose to take part in this project. These tasks are separated into 'Language', 'Executive Function and Memory', and 'Emotional and Social Participation'. Those tasks marked with an asterisk (*) are standardised assessments. You will be provided with your child's results on these tasks, if you choose to do so.

By completing these tasks, we can see what skills are related to communication in adolescents, and how communication impacts emotional wellbeing and participation with friends and family. You and your child will complete each these tasks with the same researcher. You will be speaking with a Speech Pathologist who is currently doing their PhD; who has been trained to administer these tasks, and is experienced working with teenagers. It will take **two (2) 60 minute sessions** to finish these tasks. These sessions will be held at a time that is convenient to you, at home or at Curtin University.

<u>Language Tasks</u>

- **Clinical Evaluation of Language Fundamentals – Fourth Edition (CELF-4; Semel, Wiig, & Secord, 2003) ***

  The CELF-4 will be used to check if your child has a language difficulty. It is important that we have a look at your child's language and communication skills to see how this impacts their ability to communicate at school and in the home. This task takes approximately 30-45 minutes to complete.

- **Curtin University Discourse Protocol – Adolescent (CUDP-A; Whitworth, Claessen, , & Webster, 2015)**

  The CUDP-A is a newly developed tool that includes a list of topics that your child will be asked to discuss. This assessment allows the Speech Pathologist to see how your child tells a story, gives an opinion, and recounts things that have happened in the past. These have been chosen as they reflect the types of communication your child may use in daily activities. This task takes approximately 10-15 minutes to complete. Your child's answers on this task will be audio- recorded.

- **LaTrobe Communication Questionnaire (LCQ; Douglas, O'Flaherty & Snow, 2000)**

  The LCQ is a questionnaire that will be completed by your child, which will ask them questions about their own communication such as "how often do you speak too slowly?" and "how often do you keep track of the main details of conversation?" The results of this task will allow us to see whether your child's verbal communication skills affect whether they think they are a good or bad communicator. This task takes approximately

5 minutes to complete. This is a pen-and-paper questionnaire, which will be completed with the Speech Pathologist.

Executive Function and Memory Tasks

- **Trail Making Test (D-KEFS; Delis, Kaplan, & Kramer, 2001) ***

  The Trail Making Test is a pen-and-paper task that will measure your child's ability to achieve goals while changing their behaviour based on directions given by the clinician. This task will take approximately 10 minutes to complete.

- **N-back Task (Jaeggi et al., 2010)** The N-back task is a computerised task that will measure your child's working memory. This test involves remembering and matching sequences of letters and numbers and takes approximately 15 minutes to complete.

- **Stop-signal Task (Logan, 1994)**

  A stop-signal task is another computerised task that will measure your child's attention, specifically their ability to supress automatic responses during a computerised task. Stop-signal tasks take approximately 15 minutes to complete.

- **Tower Test (Delis et al., 2001) ***

  The Tower Test is a pen-and-paper task that will measure your child's planning skills. This task involves moving disks using limited number of moves to match a picture provided by the clinician. This task takes approximately 15 minutes to complete.

- **Rey's Auditory Verbal Learning Test (RAVLT; Rey, 1964) *** The RAVLT is a pen-and-paper task that will measure your child's memory. This assessment will require them to learn sets of words and later recall them to the researcher. This test will take approximately 15 minutes to complete.

- **Behaviour Rating Index of Executive Function Screen (BRIEF; Gioia et al., 2000) ***

  The BRIEF is a pen-and-paper questionnaire completed by a parent, which will ask you questions about your child's executive functioning during daily school and social activities. The BRIEF will take approximately 2-5 minutes to complete.

Emotional and Social Participation Tasks

- **Child and Adolescent Scale of Participation (CASP; Bedell, 2004)**

  The CASP is questionnaire, completed by a parent, that your child's involvement in activities in the home, the school, and out in the community. This task takes approximately 5 minutes to complete. This will be completed in-person on an iPad.

- **Paediatric Quality of Life Inventory (PedsQL; Varni et al., 2009) ***

  This task measures your child's wellbeing during physical, social, and emotional activities. This task is included so we can look at how communication skills influence wellbeing across these areas. Both you and your child will complete this questionnaire in person on an iPad. This will take you approximately 15 minutes, and take your child approximately 5 minutes.

- McMaster Family Assessment Device (FAD; Epstein et al., 1983)

  The McMaster FAD looks into how well your family works together, solves problems, decides rules, and communicates about emotions and interests. When a child has a communication impairment, it can impact the way the family communicates with each other. We have included this task so we can look at how the child's communication skills influence family communication in the mainstream population. This task will be completed on an iPad, and will take approximately 5 minutes.

  If you have any questions regarding the assessments above please do not hesitate to contact a member of the research team. Details are provided on information sheet.

School of Occupational Therapy, Social
Work, and Speech Pathology
Curtin University
GPO Box U 1987, Perth
Western Australia, 6845

Spoken Discourse in Adolescents

Principal Information Sheet and Consent Form

Dear Principal,

My name is Elizabeth Hill and I am a PhD student at Curtin University. My PhD project is investigating how a brain injury impacts the way adolescents talk in everyday situations, for example telling a story, having a conversation with friends or explaining how to play a game. In this phase of my study I am interested in collecting data from adolescents attending mainstream high schools.

The communication skills of these participants will be compared to children of a similar age, who have a history of brain injury, to see if, and how, brain injury has changed the way these children talk. The results of this project may help speech pathologists working with school-age children with brain injury plan the intervention they provide.

What does participation in the research project involve and are there any risks?

I am seeking the participation of 180 adolescents. The project will involve assessment of communication and executive function (attention) skills. I will also be asking adolescents and parents to complete questionnaires to determine how well the participants are able to participate in usual activities. A detailed list of the assessment tasks is provided on the final page of this document.

I would like to invite your school to participate in this research. This would involve the following steps:

- As the Principal, you will provide my research information sheet and consent forms to the parents/carers of children in years 7-10.
- The parents/carers who choose to participate will return the consent forms to the student's teacher who will give them to me. Parents/carers will have the opportunity to discuss any questions they may have with me.
- I will contact each family to determine if they would prefer assessments be conducted at home or at school.
- I will come to your school and see each child on two separate days. Testing will take approximately two hours spread over two sessions (each session will take 45-60mins). Participants will be offered breaks as required.
- The language samples from the discourse task will be audio-recorded, so that scoring can take place after the sessions are completed. The audio recordings will be destroyed immediately following the completion and checking of scoring.

- There are no foreseeable risks or side effects associated with participation in this project. The tasks used in this research are similar to tasks used by Speech Pathologists working with children.

Each student who takes part will receive a **movie voucher** to thank them for their time and effort.

To what extent is participation voluntary, and what are the implications of withdrawing participation?

Participation in this study is completely voluntary. All potential participants and their parents are advised of this in the information letters. If parent/carers give permission for their child to participate in the research, they may withdraw their child, or the student may withdraw themselves, from participation at any time without consequence. If a child is withdrawn from participating in the study, all information and data will be destroyed immediately. If the project has already been published at the time a participant decides to withdraw, their contribution to research data cannot be removed from the publication. The decision about whether to participate, or to participate and then withdraw, of any participant will not affect their relationship with the research team or Curtin University.

What will happen to the information collected, and is privacy and confidentiality assured?

Information that identifies a participant or the school will be removed from the data collected. The data will be stored in a locked cupboard at Curtin University that can only be accessed by my supervisors (Dr Mary Claessen, Ass Professor Anne Whitworth & Dr Mark Boyes) and myself. All measurement records will be stored for a minimum period of 25 years, after which it will be destroyed according to the Curtin University Functional Records Disposal Authority protocol. The data are stored in this way so that, if a participant decides to withdraw, their data can be re-identified and destroyed. This is done by using a system of individual codes which are known only to the research team. The results of this study may be published, however no identifying information regarding the participants will be used. The identity of the participants and the school will not be disclosed at any time, except in circumstances requiring reporting under the Department of Education Child Protection Policy, or in the circumstance that the research team is legally required to disclose such information. Confidentiality of participant information is assured at all other times.

What are the benefits of this research for the student's education and the school?

The communication skills of these participants will be compared to children of a similar age, who have a history of brain injury, to see if, and how, brain injury has changed the way these children talk. The results of this project may help speech pathologists working with school-age children with brain injury plan the intervention they provide.

The results from this study will be used to inform teachers and speech pathologists about the impact of brain injury on communication. It will particularly help teachers and speech pathologists working with adolescents with brain injury provide the intervention and teaching they require. As such, it will add to the evidence base to support the practice of both teachers and speech pathologists.

How do I know that the people involved in this research have all the appropriate documentation to be working with children?

Under the Working with Children (Criminal Record Checking) Act 2004, researchers that work with children must pass a Working with Children Check. I will provide you with a copy of my Working with Children check at the beginning of the first assessment session.

Is this research approved?

Approval has been received from the Curtin University Human Research Ethics Committee (HRE2016-0219). Any questions or verification of approval for this study can be obtained by contacting the Committee.

Address: Curtin University Human Research Ethics Committee, c/- Office of Research and Development, Curtin University, GPO Box U1987, Perth, 6845.
Telephone: 9266 9223
Email: hrec@curtin.edu.au

What if I have further questions about this research project?

Please do not hesitate to contact me or any member of the research team if you have any questions about the project. I can be contacted by email at Elizabeth.j.hill@postgrad.curtin.edu.au. You may also wish to contact members of the research team, Dr. Mary Claessen (m.claessen@curtin.edu.au) or 9266 3472, Associate Professor Anne Whitworth (anne.whitworth@curtin.edu.au) and Dr. Mark Boyes (mark.boyes@curtin.edu.au)

How do I indicate my willingness for the school to be involved in this project?

If you have read the above information carefully and have had all questions about the research project answered to your satisfaction, and are willing for your school to participate, please complete the Consent Form attached.
If you would like to be involved, please post this form to:

Dr Mary Claessen
School of Psychology and Speech Pathology
Curtin University
GPO Box U 1987, Perth
Western Australia, 6845

Kind regards,

Elizabeth Hill	Dr Mary Claessen	Ass Pro Anne Whitworth
Speech Pathologist	Speech Pathologist	Speech Pathologist
PhD Candidate	Supervisor /Senior Lecturer	Supervisor/Ass Professor
Curtin University	Curtin University	Curtin University

Dr Mark Boyes
Psychologist
Supervisor and Research Fellow
Curtin University

This study has been approved by the Curtin University Human Research Ethics Committee (Approval Number HRE2016-0219). The committee is comprised of members of the public, academics, lawyers, doctors and pastoral carers. If needed, verification of approval for this study can be obtained by contacting the Committee: Curtin University Human Research Ethics Committee, c/- Office of Research and Development, Curtin University, GPO Box U1987, Perth, 6845. Telephone: 9266 9223, Email: hrec@curtin.edu.au.

School of Occupational Therapy, Social Work, and
Speech Pathology, Curtin University
GPO Box U 1987, Perth, Western Australia, 6845

Spoken Discourse in Adolescents

Consent Form for School Principal

• I have read this document and I understand the aims, procedures, and risks of this project.

• I have been given the opportunity to ask any questions I may have had, and these have been answered to my satisfaction.

• I am willing for this school to be involved in the research project, as described.

• I understand that participation in this project is completely voluntary.

• I understand that participant responses on one task will be audio recorded to allow scoring to take place.

• I understand that this school may withdraw its participation in this project at any time, without consequence.

• I understand that the results of this research may be published in a journal, provided that the participants or school are not identified in any way.

• I understand that the school and the Department of Education will be provided with a copy of the overall research findings upon the completion of this project.

• I understand that the parents will be provided with individual assessment results and information about appropriate services if further follow-up is required.

Name of School (please print): ____

Name of School Principal (please print): ____

Signature of School Principal: ____

Date (DD/MM/YYYY): _____ / _____ / ________

School of Occupational Therapy, Social Work, and
Speech Pathology, Curtin University
GPO Box U 1987, Perth, Western Australia, 6845

Spoken Discourse in Adolescents

Principal Assessment Information Sheet

This information sheet will provide the details of each assessment in this project. Assessment will cover language, cognitive function, and participation in the home, school and community, as well as emotional and family well-being. Each assessment will be given by a speech pathology PhD student.

Language Assessments

1. **Clinical Evaluation of Language Fundamentals – Fourth Edition (CELF-4; Semel, Wiig, & Secord, 2003).**
   The CELF-4 will be used to screen for the presence of a language disorder. This assessment will take approximately 45 minutes to complete.
2. **Curtin University Discourse Protocol – Adolescent (CUDP-A; Whitworth, Claessen, , & Webster, 2015)**
   The CUDP is a list of topics about which the student will be asked to discuss. This assessment will allow the investigator to see how the student tells a story, and gives an opinion and recounts something that has happened to them. The student's responses will be audio recorded for later analysis. This assessment will take approximately 15 minutes to complete.
3. **LaTrobe Communication Questionnaire (LCQ; Douglas, O'Flaherty & Snow, 2000)**
   The LCQ consists of two reports. One is a self-report, completed by the student, and the other is a report completed by a parent/guardian or friend. This assessment will be used to measure how well the student thinks they communicate and how well the parent/guardian or friend believes the student communicates. This assessment will take approximately 10 minutes to complete.

Executive Function Assessments

4. **Trail Making Test of the Delis Kaplan Executive Function System (D-KEFS; Delis, Kaplan, & Kramer, 2001)**
   The Trail Making Test will be used to measure your students' ability to achieve goals while changing their behaviour based on directions given by the clinician. This task will take approximately 10 minutes to complete.
5. **N-back Task (Jaeggi et al., 2010)**
   The n-back task is a computer program that will be used to assess your students' working memory. This test involves remembering and matching sequences of letters and numbers and takes approximately 15 minutes to complete.
6. **Stop-signal Task (Logan, 1994)**

A stop-signal task will be used to measure your students' attention, specifically their ability to supress automatic responses during a computerised task. Stop-signal tasks take approximately 15 minutes to complete.

7. **Tower Test – Delis-Kaplan Executive Function System**
   The ToL is a computerised puzzle that will be used to measure your students' planning skills. This task involves moving disks using limited number of moves to match a picture provided by the clinician. The ToL task takes approximately 15 minutes to complete.
8. **Behaviour Rating Index of Executive Function (BRIEF; Gioia et al., 2000)**
   The BRIEF is a parent and teacher questionnaire which measures their child's executive functioning during school and social activities. The BRIEF will take approximately 10 to 15 minutes to complete.
9. **Rey's Auditory Verbal Learning Test (RAVLT; Rey, 1964).**
   The RAVLT will measure the students' memory. This assessment will require them to learn sets of words and later recall them to the researcher. This test will take approximately 15 minutes to complete.

<u>Psychosocial Health Assessments</u>

10. **Child and Adolescent Scale of Participation (CASP; Bedell, 2004)**
    The CASP is a parent questionnaire that will be used to measure the extent of the student's involvement in activities within the home, school, and community. The CASP will take approximately 10 minutes to complete.
11. **Child Health Questionnaire (CHQ; Landgraf & Ware, 1996)**
    The CHQ is a questionnaire that the student will complete, which will be used to measure their quality of life. This assessment will take approximately 15 minutes to complete.
12. **McMaster Family Assessment Device (FAD; Epstein et al., 1983)**
    The McMaster FAD will be used to determine measure of family functioning. The student will be asked questions about how well their family communicates with each other, solves problems, and decides rules, as well as about their family's emotions, and interest in activities. This assessment will take approximately 10 minutes to complete.

If you have any questions regarding the assessments above please do not hesitate to contact a member of the research team. Details are provided above

Communication in Adolescence

Curtin University

Help us better understand the way teenagers talk!

A PhD student at Curtin University is conducting research* on the way teenagers with and without language difficulties communicate across different tasks at home, school, and in the community, e.g. telling a friend what happened on the weekend, expressing an opinion on social issues, or explaining a topic in class.

The project will look at:

- Communication skills in teenagers aged from **12 to 15 years**
- Whether these skills are related to other processes such as executive function, attention, and memory
- How the way teenagers communicate influences the way they feel and how much they take part in daily activities
- How talking varies across different types of communication. For example, telling a parent what happened at school versus explaining the rules of a game to a friend.

What is involved?

This project will involve completing a variety of tasks over **two 45-60 minute sessions** with a speech pathologist who is experienced in working with adolescents. These tasks will tap into language and communication, as well as other skills needed for everyday communication. The tasks will involve answering questions, talking, and solving puzzles. Participants can be seen at home or at Curtin University, and can be provided with a summary report of performance across all areas of assessment.
Everyone will receive a **movie voucher** to thank you for your time and effort in being involved in the study!

Who should I contact?

If you are interested or have any questions, please contact Lizz on 0437 514 025, or by email at Elizabeth.j.hill@postgrad.curtin.edu.au

Your response is greatly appreciated!

*Ethics approval obtained from Curtin University.

Appendix E.2 Example Curtin HREC-approved assessment report

Curtin University

School of Psychology and Speech Pathology

Establishing the 'Norm':

Discourse skills in Australian adolescents, the role of cognitive function, and the impact on social participation and emotional wellbeing

Assessment Summary (12 years)

Child's name:

Date of Session One: Date of Session Two:

Thank you, and your child, for being involved in this research project. Your child's scores on the assessment tasks **have/have not** indicated the presence of some difficulties, which **may/may not** warrant further assessment. Please see the report below.

At the end of this letter, we have provided a list of local speech pathology clinics and information regarding accessing a private speech pathologist, or psychologist if applicable.

If you wish to discuss your child's results in detail, please contact me one of my supervisors (contact details are provided below).

LANGUAGE TASKS

The Clinical Evaluation of Language Fundamentals – Fourth Edition
This language test has four main subtests. The total score reported is called the *Core Language Score.* The average score is 100, and a score between 85 and 115 is within the average range.
Your child received a standard score of ___
This score is: ***within/outside of the average range***
For the individual subtests the average score is 10, and a score between 8 and 12 is within the average range.

The Concepts and Following Directions subtest is used to assess the ability to understand and interpret spoken sentences of increasing length and complexity. For this subtest, your child was asked to point to different pictures according to a verbal instruction. This subtest can give information about how a child understands spoken sentences in the classroom and at home.

Your child's subtest score was: ___

This score is: ***within/outside the average range***

The Recalling Sentences subtest is used to assess a child's ability to process simple and complex sentence structures. Your child was asked to repeat sentences of increasing length and complexity (e.g. *Repeat this sentence exactly as I say: 'Does anyone know who the new teacher is?'*). This subtest can give information about a child's ability to tune into and retain spoken information.

Your child's subtest score was: ___

This score is: ***within/outside of the average range***

The Formulated Sentences subtest is used to assess a child's ability to create a grammatically correct sentence using a given word. Your child was asked to look at a picture and make up a sentence about it using a specific word (e.g. *Make up a sentence about this picture using the word 'running'.*). This subtest can give information about a child's abilities in storytelling and sharing personal experiences.

Your child's subtest score was: ___

This score is: ***within/outside of the average range***

The Word Classes subtest was used to assess a child's ability to understand how two words are related, and explain that relationship. Your child was required to choose which two of four spoken words were related and explain their choice (e.g. *Listen to these four words: pillow, door, blanket, lamp. Which two go together best? Why?*). This subtest gives information about a child's vocabulary, and how it is organised.
Your child's subtest scores were:
This score is: ***within/outside of the average range***

The Word Definitions subtest is used to assess the child's ability to define words of increasing difficulty. Your child was required to provide a definition of a spoken word, which was provided in a sentence (e.g. *'echo', Josh asked "is there an echo in here?").* This subtest gives information about your child's vocabulary and knowledge of word meanings.
Your child's subtest score was: ___
This score is: ***within/outside of the average range***

EXECUTIVE FUNCTION AND MEMORY TASKS

Rey's Auditory Verbal Learning Test
This assesses the child's ability to remember and learn lists of words. The average score on this task is 47. A score between 42 and 52 is within normal range.
Your child's score was: ___
This score is: ***within/outside of the average range***

Clinical Evaluation of Language Fundamentals – Digit Span Task
This task looks at your child's ability to repeat random lists of numbers of increasing length in forwards and backwards order. The average score of this task is 10, and a score between 8 and 12 is within the average range.
Your child received a subtest score of: _____
This score is: ***within/outside of the average range***

Delis Kaplan Executive Function System – Tower Test

This task assesses the child's ability to plan their actions to achieve a goal. A higher score tells us the child has used too many moves, or is relying on a trial-and-error strategy.
This is a measure of the child's planning, spatial problem-solving abilities, and inhibition.
Your child's scale score was: ____
This score is: ***within/outside of the average range***

Delis Kaplan Executive Function System – The Trail-making Test
This task provides information on the child's processing speed, flexibility of thinking, and problem-solving skills.
Your child's scale score was: ___

This score is: ***within/outside of the average range***

Behaviour Rating Index of Executive Function
This task screens for potential difficulties with a child's executive behaviours in the school and home environment. This short screen looks into the child's skills in terms of task completion, attention span, emotional and behavioural regulation.
For this task, a score above 19 suggests the child may have difficulty with executive function.
Your child's score was: ___

This score is: ***within/outside of the average range***

EMOTIONAL AND SOCIAL FUNCTIONING TASKS

*****

Parents will only be provided with the results of emotional/social functioning tasks if their child's performance indicates they may be at risk of reduced wellbeing

*****

Paediatric Quality of Life Inventory (PedsQL) – Parent report
The PedsQL Parent Report assess your perception of your child's health-related quality of life across four areas: physical, emotional, social, and school functioning. Scores range from 0 to 100. The average score on this task is 81. A score below 65 indicates lower levels of quality of life.
Your child's total score was:
This score indicates that:

a) You have reported your child's health-related quality of life to be lower than other children their age. This may warrant consideration for discussion with a Clinical Psychologist.
b) You have reported your child's health-related quality of life to be similar to other children their age.

Paediatric Quality of Life Inventory (PedsQL) – Child report
The PedsQL Child Report assess your child's perception of their own health-related quality of life across four areas: physical, emotional, social, and school functioning. Scores range from 0 to 100. The average score on this task is 83. A score below 69 indicates lower levels of quality of life.
Your child's total score was:
This score indicates that:

a) You have reported your child's health-related quality of life to be lower than other children their age. This may warrant consideration for discussion with a Clinical Psychologist.
b) You have reported your child's health-related quality of life to be similar to other children their age.

McMaster Family Assessment Device

This task aims to look at how well the child's family works together to solve problems, do activities together, and discuss emotions. The General Functioning score reflects the overall health and wellbeing of the family. A score greater than 2.0 indicates the family may be having difficulty with their overall functioning.

Your score was:

This score indicates:

a) Your family may be experiencing difficulties communicating with each other. This may warrant further consideration with a clinical psychologist.
b) No cause for concern regarding family functioning.

Please do not hesitate to contact a member of the research team if you have any questions about the above information.

9266 3472 or email us on
M.Claessen@Curtin.edu.au
Anne.whitworth@curtin.edu.au
m.boyes@curtin.edu.au

Kind regards,
Elizabeth Hill
PhD Student and Principal Investigator
Curtin University
(e) Elizabeth.j.hill@postgrad.curtin.edu.au
(ph) 0437514025

***

The following details will be provided if participants' scores indicate 'at risk' performance.

***

Speech Pathology:
Information about referral to your local public speech pathology service can be found at: childdevelopmentservice@health.wa.gov.au
A private speech pathologist can be found via this website:

- http://www.pspawa.com.au/find-a-speech-pathologist/

Based on your address, your closest private speech pathologist is:

Appendix F CUDP-A Materials

Appendix F.1 CUDP-A Script

GENERAL COMMENTS

Keep dialogue during tasks to a minimum. You may use as many nonverbal prompts as required (e.g. head nods, facial expression, and eye contact). You may verbally prompt the participant **once** during each task (e.g. Tell me more, is there anything else? Is that all).

BEGIN RECORDING

"Thanks for coming to talk to me today! I am going to ask you to talk to me about a range of different things. For each question, say whatever comes to mind. I'll try my best not to interrupt you. I have my recorder with me so I can listen to what we say later on."

RECOUNT

The aim is to trigger and elicit a recent memory of an event that can be recounted. Aim to elicit three topics.

I'll start by asking you to tell me about some specific things that have happened to you.

1. **Weekends -** On the weekends we usually do a lot of things like play sport catch up with friends, or do homework. Can you tell me what you did last weekend?
2. **Accident / Injury -** Have you ever hurt yourself or had an accident? Can you tell me what happened?

    Alternative if no: What about one of your friends or family? What happened to them?

3. **Holiday -** We all love to go on holiday. When did you last go on holiday? Can you tell me what you did?

    ALTERNATIVE: Christmas / Celebration. We all like to celebrate traditions such as Christmas or Hanukah. What do you celebrate with your family and friends? Can you tell me what you did last _______?

EXPOSITION

The aim is to trigger and elicit an explanation of the topics, below. Aim to elicit three topics.

Note: If the participant provides a definition, provide **one** verbal restatement of task, e.g. "Great, you've told me what it is, now tell me what you know about it".

Now I'm going to ask you about some topics. I want you to tell me what you know about them.

1. **Bullying –** Tell me everything you know about **bullying**
2. **Social Media -** Tell me everything you know about **social media**.
3. **Obesity -** Tell me what you know about **obesity**.

   ALTERNATIVE: Pollution – Tell me everything you know about **pollution.**

PERSUASION

The aim is to trigger and elicit an opinion, and justification from the participant. Aim to elicit three topics.

Now I'm going to ask you some questions. I want you to give me your opinion and explain to me why you think that way.

1. **Social Media -** People say that social media is having a bad influence on teenagers. Do you think social media is a bad influence on young people and why?
2. **School Uniform -** When I was at school, students used to complain about wearing a school uniform. Do you think school uniforms should be compulsory for everyone and why?
3. **School Sport -** Not every student is good at sport. Do you think sport should be compulsory at school and why?

   ALTERNATIVE: Girls and boys in sport – Some people think some sports are for boys only and some sports are for girls only. Do you think boys and girls should be able to play the same sport and why?

NARRATIVE

Aim to elicit a fictional narrative based on the Norman Rockwell paintings a) The Young Lady with the Shiner (Figure 1; Rockwell, 1953) and b) The Runaway (Figure 2; Rockwell, 1958).

Now we are going to something a bit different. I want you to tell me two stories.

I will show you two pictures. Use each picture to tell me two made up stories based on what is happening in the picture. I will give you a couple of minutes to think of each story.

1. *The first painting is called 'The Young Lady with the Shiner'. Tell me a story based on this picture.*
2. **The Runaway** – *This painting is called 'The Runaway'. Tell me a story based on this picture*

Figure 1. The Young Lady with the Shiner (Rockwell, 1953).

Figure 2. The Runaway (Rockwell, 1958).

References

Rockwell, N. (1953). The Young Lady with the Shiner. Hartford, CT: Wadsworth Antheneum.

Rockwell, N. (1958). The Runaway. Stockbridge, MA: Norman Rockwell Museum.

Appendix F.2 CUDP-A Scoring Protocol

Feature	Definition	Code	Example
Micro-linguistic			
SALT codes	SALT measures obtained from the Standard Measures Report. Coded as per SALT guidelines (Miller & Iglesias, 2018).	–	
Mazes	Filled pauses, false starts, repetitions, and reformulations. Code as per SALT guidelines (Miller & Iglesias, 2018)	( )	*Then (he um) he went to (um) the shops*
Clausal density	Independent clauses PLUS one or more finite. Finite clauses contain a subject and a verb but does not express a complete thought. Types include:	–	
	Adverbial clause: Describes a verb (in the main clause) and answers one of these questions: where? Why? When? How?	–	<u>*When Peter ate the apples in the kitchen*</u>, it made a big mess.
	Adjective clause: Describes the noun (in the main clause) and answers: Which one? What kind?	–	John read the book <u>*that I gave him.*</u>
	Noun clause: Names a person, place, thing or idea. This clause can function as a subject, complement, direct/indirect object, and preposition. Includes 'that' clauses.	–	You can be <u>*whoever you want.*</u> <u>*I think that*</u> she should go home.
	Direct speech (quotation): A report of the exact words used by a person	–	He said <u>*I want to go home.*</u>
	Indirect speech: A report on what someone else said without using exact words	–	He said that <u>*he wanted to go home.*</u>
Micro-structural			
Correct tie	Referent can be found and defined with no ambiguity.	[R2]	My friends and I went to the beach . <u>*We*</u> **[R2]** *had a great time.*

Feature	Definition	Code	Example
Incomplete tie	Referent not provided in the text.	[R1]	Sally won a medal. *We* **[R1]** *were very proud.*
Erroneous tie	Referential tie guides listener to ambiguous or incorrect information.	[R0]	Erica and Sally went to the party. *He* **[R0]** *danced all night.*
Macro-structural Local coherence			
Score of 5	The topic of the preceding utterance is continued by elaboration; temporal sequencing; enumeration of related examples; or maintaining the same actor, subject, action or argument as the focus	[5]	O.J. was a football star. *He was very famous.* **[5]**
Score of 4	The utterance contains multiple clauses, wherein one clause definitely relates to the content in the preceding utterance but another may not	[4]	*O.J. was a football star.* *I think that he was very famous.* **[4]**
Score of 3	The utterance topic generally relates to that of the preceding utterance, but with a shift in focus from the subject or activity of the preceding utterance; or the utterance is referentially vague or ambiguous so that the relation to the preceding utterance must be inferred.	[3]	O.J. was a football star. *He had a lot of things going on.* **[3]**
Score of 2	The utterance contains multiple clauses, wherein one possibly relates to the content of the preceding utterance but the other(s) may not.	[2]	O.J. was a football star. *I think he had a lot of things going on.* **[2]**
Score of 1	The utterance has no relationship to the content of the immediately preceding utterance. It may be a radical topic shift, a comment on the discourse, or an unintelligible utterance	[1]	O.J. was a football star. *That's all I know.* **[1]**
	Utterances directly following abandoned utterances that contain impoverished information	[1]	They are also like > I like them a lot. **[1]**
Global coherence[b]			
Score of 5	The utterance provides substantive information related to the general topic.	[5]	On the topic of a speaker's accident: *I was taken to the hospital by ambulance.* [**5**]

Feature	Definition	Code	Example
Score of 4	The utterance contains multiple clauses, wherein one clause relates directly to the topic and the other relates indirectly. *In Persuasive samples I think, I believe (or similar) considered score of [5].*	[4]	*I was taken to the hospital, which was a first for me.* **[4]**
Score of 3	The utterance provides information possibly related to the general topic or is an evaluative statement without providing substantive information, or the topic must be inferred from the statement.	[3]	*The hospital is a confusing place.* **[3]**
Score of 2	The utterance contains multiple clauses, wherein one clause possibly relates to the general topic and one does not.	[2]	*The hospital is a confusing place, as usual.* **[2]**
Score of 1	The utterance is unrelated to the general topic or is a comment on the discourse.	[1]	*That's all I have to say.* **[1]**
Correct Information Unit Analysis [c]			
Word	Words must be intelligible in context to someone who knows the picture(s) or topic being discussed. (Nicholas & Brookshire, 1993, p.36)	–	Follow definitions and coding guidelines in Nicholas and Brookshire (1993).
CIU	CIUs are words that are intelligible in context, accurate in relation to the topic, and relevant to and informative about the content of the topic. (Nicholas & Brookshire, 1993, p.36)	–	as above
Super-structural Common codes			
Restatement of Question	Speaker begins discourse by restating or reformulating the stimulus	[RSQ]	On the topic weekend: *Ok, what I did last weekend.* **[RSQ]**
Schema Deviation	Use this code for every instance of difference between discourse sample schema and predefined schema below. This includes missing core schema components. Justification for code must be provided in parentheses { }.	[SD]{}	On the topic of social media (Expository): *All my friends have it.* **[ES] {missing definition}**

Feature	Definition	Code	Example
Order Deviation	Use this code when the information contained within an utterance has been produced out of order of defined schema. Justification for code must be provided in parentheses { }.	[OD]{}	On the topic of bullying: *The schools always try and stop it.* *Bullying is when someone teases someone else repeatedly.* **[EO] {definition}**
Genre Shift	Use this code when the speaker shifts genres within a topic. A Genre Shift code is used only when the schema structure changes substantially. Justification for code must be provided in parentheses { }.	[GS]{}	On the topic of social media (Expository): *Yeah social media can be really dangerous.* *Everyone has it these days.* *My sister had a bad experience with social media.* *It was three years ago when someone stole her phone.* **[GS] {speaker continues Recount}xs**
Evaluative statement	Use this code when utterance contains evaluative comment about the topic.	[EV]	On the topic of last holiday: *Last year I went to Italy.* *Yeah, it was so much fun.* **[EV]**
End	Explicit End maker	[End]	*The end* . *That's it.* **[End]**
Recount and Narrative [d]			

Feature	Definition	Code	Example
Orientation information	Orientation of who/where/when/other 1. Character 2. Location 3. Time 4. Other: Use this code when the speaker has provided orientating information, but it does not come under one of the above. This code is also used when the speaker has summarised their response before providing more detail	 [OC] [OL] [OT] [OO]	 *This all happened when I was seven at my old house.* **[OT] [OC] [OL]** *The only injury I can think of is when I broke my arm falling from a tree at home.* **[OO]**
Initiating Event	There may be no [IE] present. What happened (kick off?). Causal kick-off, some event that initiates the series of events that follow, a reason.	[IE]	*Last weekend my cat ran away.* **[IE]**
Response	If there is an IE this MAY be followed by a response/plan. Response to initiating event and maybe character plan	[Res]	Last weekend my cat ran away. [IE] *I decided to find him.* **[Res]**
Event(s)	What happened and often a series of repeated events or sub-events.	[E]	*I went to the shops.* **[E]**
Elaboration	Use this code when the speaker provides new additional information to expand on an event or accommodate for an unfamiliar listener OR expand on an event, e.g.	[EL]	Then, I went to the swimming pool. [E] *It is the biggest swimming pool in Australia.* **[EL]**
Reflective Comment (*NARRATIVE ONLY)*	Utterance(s) that describe character reflection. Present in more complex narratives that involve meta-awareness of characters' thoughts, observations, and reactions.	[RC]	The little boy surprised me by being great at poker. [E] *A little boy good at gambling who would have thought?* **[RC]**
Conclusion	Concluding statements that are part of the resolution of the story	[Conc]	She got into a lot of trouble for fighting back. *so, she never fought back again.* **[Conc]**

Feature	Definition	Code	Example
Expository			
Thesis	Utterance(s) that introduce the topic to the listener. Usually a definition and may include a general comment on the topic.	[Th]	*Obesity is when you are way too fat, which is a really serious problem nowadays.* **[Th]**
Sub-category	Utterance(s) that provide **new** information about the topic, e.g. cause/consequences.	[SC]	Obesity is when you are way too fat. [Th] *It is caused by when you eat way too much bad foods.* **[SC]**
Elaboration	Utterance(s) that provide **new and additional** information relating to a sub-category.	[EL]	*These foods are things like chips, coke, lollies, burgers and stuff.* **[EL]**
Conclusion	Comes to a point of view, may have reflective / evaluative comment/statement.	[Conc]	*So yep, obesity is a really bad thing that needs to be reduced.* **[Conc]**
Persuasive			
Thesis	Utterance(s) that state the speaker's opinion. This should be first in the sample.	[Th]	*I think school uniforms should not be compulsory.* **[Th]**
Supporting Arguments	Utterance(s) that provide a clear supporting argument of the speaker's thesis	[SA]	I think school uniforms should not be compulsory. [Th] *They are too expensive.* **[SA]**
Elaboration	Utterance(s) that provide additional detail to supporting/counter arguments.	[EL]	They are too expensive. [SA] *My school uniform was one-hundred dollars!* **[EL]**

Feature	Definition	Code	Example
Counter Arguments	Utterance(s) that provide clear counter-arguments to the speaker's thesis. Counter arguments may not be present.	[CA]	My school uniform was one-hundred dollars! [EL] *I guess they do stop bullying, though.* **[CA]**
Conclusion	Utterance(s) that come to a point of view.	[Conc]	*Overall no, they should not be compulsory.* **[Conc]**

Note: [a] Scoring guideline from Liles (1985); [b] Guidelines and examples from Glosser & Deser (1990); [c] Nicholas & Brookshire (1993); [d] based on Stein and Glenn (1979).

Appendix G Chapter 4 Appendices

Appendix G.1 Results of Bivariate Correlations between CUDP-A Variables

Measure	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. C-units															
2. NDW	**.94****														
3. Mazes	**.84****	**.74****													
4. %Maze Words	.12	.02	.53**												
5. MLUw	.07	**.28****	.05	**-.16***											
6. Clausal density	-.15	-.05	-.08	-.06	**.53****										
7. Total referential ties	**.91****	**.91****	**.72****	.03	**.18***	-.10									
8. Cohesive adequacy	**.47****	**.56****	**.36****	-.11	**.22***	-.04	**.47****								
9. %CIU	-.18*	-.05	**-.42****	**-.71****	**.27****	**.21***	-.11	.12							
10. CIUpm	.09	.15	.04	-.06	**.23***	**.18***	-.09	**.22***	**.30****						
11. Local coherence	-.04	.01	-.08	-.08	.15	.12	-.09	.05	**.38****	**.23***					
12. Global coherence	**-.37****	**-.28****	**-.37****	**-.21***	**.28****	**.17***	**-.24****	-.07	**.48****	**.23***	**.44****				
13. Schema deviations	**.63****	**.56****	**.54****	.105	.02	**-.19***	**.53****	**.23***	**-.19***	.06	.003	**-.33****			
14. Genre shifts	**.61****	**.54****	**.57****	.10	.01	-.08	**.52****	**.23***	**-.19***	-.04	-.02	**-.35****	**.45****		
15. Order deviations	**.32****	**.30****	**.28****	.01	.00	-.09	**.33****	.16	-.05	-.09	-.07	**-.19***	**.23***	**.42****	
16. RSQs	**.17***	.15	.10	.04	-.20*	-.14	.13	.05	-.11	-.04	-.13	**-.23***	**.35****	.05	.07

Note: Values reported are Pearson's correlation coefficients (*r*). Bolded values are significant at ** $p<.001$, *$p<.05$. NDW = number of different words; MLU = mean length of utterance in words; CIU = correct information unit (Nicholas & Brookshire, 1993); RSQ = restatements of question.

Appendix G.2 Results of Bivariate Correlations between CELF-4 Core Language Score and CUDP-A Variables by Level of Analysis

Level of analysis	Measure	Genre				
		All	Recount	Exposition	Persuasive	Narrative
Micro-linguistic	Total utterances	**.25****	**.18***	**.22***	**.25***	**.19***
	Mean length of utterance (words)	**.29****	**.26 ****	**.18***	**.25***	.11
	Number of different words	**.35****	**.26 ****	**.28****	**.35****	**.30****
	Total maze words	.08	.05	.06	.07	.08
	Percentage maze words	**-.17***	**-.18***	**-.14***	**-.21***	.01
	Clausal density	.08	.15	-.06	.03	.09
Micro-structural	Total referential ties	**.27****	**.23 ***	**.21***	**.20***	**.22***
	Cohesive adequacy	**.22***	**.17***	.15	.14	.10
Macro-structural	Percentage correct information units	**.19***	**.16***	**.19***	.12	.08
	Correct information units per minute	.15	.14	**.17***	.11	.13
	Local coherence	.13	.11	**.18***	.09	-.08
	Global coherence	.03	-.03	.12	-.02	-.04
Super-structural	Schema deviations	.14	.10	.20	.07	.14
	Genre shifts	.02	.00	.03	-.04	.00
	Order deviations	.07	**-.18***	.01	-.01	.00
	Restatements of question	**.17***	.05	**.19***	.13	.00

Note: Values reported are Pearson's correlation coefficients (r). Bolded values are significant at ** $p<.001$, *$p<.05$.

Appendix H Chapter 5 Appendices

Appendix H.1 Descriptive Statistics for Micro-linguistic Variables across Genres and Age groups

Measure	Grp	Recount		Exposition		Persuasive		Narrative	
		M(SD)	Range	*M(SD)*	Range	*M(SD)*	Range	*M(SD)*	Range
Productivity Total c-units	1	39.76 (43.06)	9 – 234	21.12 (23.55)	5 – 143	24.03 (14.30)	9 – 80	33.76 (28.14)	5 – 159
	2	46.04 (44.72)	11 – 200	25.26 (20.33)	4 – 90	30.18 (20.31)	7 – 115	34.70 (29.64)	7 – 123
	3	31.67 (31.97)	7 – 187	18.87 (14.64)	4 – 58	25.87 (22.54)	6 – 108	27.15 (17.17)	3 – 71
	4	44.17 (40.21)	7 – 185	21.26 (13.20)	6 – 70	30.92 (28.17)	7 – 169	41.34 (40.53)	5 – 219
Lexical diversity NDW per 50 words	1	21.3 (4.3)	10.2 – 28.7	28.4 (24)	6.9 – 142.3	17.4 (10.8)	2.5 - 53.9	21.8 (15.2)	5.2 - 80.8
	2	22.2 (5.6)	1.6 – 53.8	32.4 (18.4)	4.8 - 66.9	19.1 (9.7)	1.6 – 53.8	26.4 (13.7)	5 - 69
	3	21.1 (5.4)	10.5 – 34.5	29.6 (27.4)	5.8 – 131.5	17.6 (10.4)	2.1 – 45.6	23.5 (11.5)	6 – 66.7
	4	22.6 (5.6)	10.7 – 33.8	27.5 (18)	2.6 – 70.6	17.7 (8.4)	3.3 – 37.5	23.6 (11.5)	3.3 – 46.3
Dysfluency Total maze words	1	22.21 (37.59)	3 – 209	15.61 (25.90)	1 – 153	16.70 (14.90)	1 – 83	13.15 (17.05)	0 – 89
	2	21.56 (21.49)	1 – 104	17.76 (16.57)	3 – 83	19.74 (16.31)	3 – 85	13.46 (15.67)	0 – 74
	3	15.74 (17.36)	0 –90	15.56 (13.23)	1 – 57	18.28 (20.06)	2 – 91	12.21 (18.14)	0 – 113
	4	25.35 (28.47)	2 – 154	19.68 (13.17)	2 – 60	24.84 (28.01)	2 – 169	20.50 (28.53)	0 – 146
%Maze words	1	9.21 (4.75)	2 – 21	12.36 (7.94)	1 – 29	10.24 (4.95)	2 – 18	6.76 (5.89)	0 – 20
	2	8.72 (4.48)	1 – 21	12.94 (6.19)	2 – 29	10.34 (4.95)	3 – 20	6.34 (3.97)	0 – 15
	3	9.31 (4.73)	0 – 24	14.90 (7.61)	1 – 31	10.90 (4.69)	1 – 20	6.15 (5.87)	0 – 31
	4	10.13 (4.71)	2 – 22	13.92 (5.69)	5 – 26	10.92 (6.49)	1 – 25	6.55 (4.03)	0 – 16
Morpho-syntactic complexity MLUw	1	7.59 (1.08)	4.91 – 9.75	8.57 (1.92)	4.75 – 13.07	10.51 (2.08)	6.68 – 14.42	10.30 (1.79)	7.74 – 16.20
	2	8.08 (1.22)	4.40 – 10.26	8.44 (1.76)	4.83 – 11.93	10.54 (2.16)	5.67 – 15.67	10.07 (2.09)	6.13 – 15.57
	3	7.46 (1.55)	4.44 – 11.38	8.31 (1.94)	6 – 13.75	10.09 (2.33)	5.75 – 18	10.72 (2.67)	7.32 – 19.23
	4	7.97 (1.10)	5.60 – 9.93	9.24 (1.94)	6 – 13.75	11.60 (3.00)	6.63 – 18.65	10.53 (2.42)	6.48 – 18.80
Clausal density	1	1.11 (.26)	.73 – 240	1.37 (.30)	.91 – 2.57	1.69 (.51)	1.10 – 4	1.32 (.25)	.48 – 1.76
	2	1.15 (.15)	.68 – 1.68	1.29 (.19)	.91 – 1.75	1.61 (.41)	.62 – 2.92	1.31 (.19)	.94 – 1.82
	3	1.14 (.15)	.88 – .154	1.28 (.24)	.57 – 2.00	1.56 (.30)	1 – 2.33	1.32 (.21)	1.06 – 2

Measure	Grp	Genre							
		Recount		Exposition		Persuasive		Narrative	
		M(SD)	Range	*M(SD)*	Range	*M(SD)*	Range	*M(SD)*	Range
	4	1.07 (.19)	.55 – 1.56	1.31 (.31)	.92 – 2.44	1.72 (.49)	.92 – 3.44	1.43 (.42)	1 – 3.67

Note: Grp = Age groups (1 = 12-year-olds, 2 = 13-year-olds, 3 = 14-year-olds, 4 = 15-year-olds). NDW = number of different words; MLUw = mean length of utterance in words.

Appendix H.2 Descriptive Statistics for Micro-structural Variables Across Genres and Age Groups

Measure	Group	Genre: Recount M(SD)	Recount Range	Exposition M(SD)	Exposition Range	Persuasive M(SD)	Persuasive Range	Narrative M(SD)	Narrative Range
Cohesive frequency									
Referential ties per 50 words	1	3.5 (1.6)	1.2 – 9	4.5 (1.6)	1.5 – 7.9	3.2 (1.7)	.5 – 6.3	3.6 (1.5)	1.2 – 7.1
	2	3.1 (1.1)	.8 – 6	4.4 (1.4)	.5 – 7.4	3.2 (1.4)	0 – 6.9	3 (1.4)	.5 – 7
	3	3 (1.3)	.8 – 6.7	4.3 (1.5)	1.9 – 6.7	2.9 (1.2)	.8 – 5.6	3.1 (1.4)	1 – 7.1
	4	3.6 (1.5)	1.4 – 9.2	4.3 (1.5)	0 – 8.5	3.2 (1.2)	1.1 – 7.4	3.3 (1.5)	1.3 – 10.2
Cohesive adequacy									
% Correct ties of total ties	1	61.62 (20.40)	14.29 – 100	68.14 (30.64)	0 – 100	55.73 (26.19)	0 – 95.12	91.68 (15.69)	41.38 – 100
	2	65.68 (23.94)	0 – 100	62.29 (32.06)	0 – 100	58.31 (26.37)	0 – 100	92.52 (13)	44.44 – 100
	3	59.14 (24.07)	0 – 100	56.69 (37.91)	0 – 100	50.31 (30.92)	0 – 100	88.63 (23.15)	0 – 100
	4	63.66 (29.57)	0 – 100	66.73 (33.93)	0 – 100	55.31 (27.47)	0 – 100	90.95 (14.50)	18.92 – 100

Note: Group = Age groups (1 = 12-year-old; 2 = 13 year – old ; 3 = 14 year – old , 4 = 15 year – old).

Appendix H.3 Descriptive Statistics for Macro-structural Variables across Genres and Age Groups

		Genre							
		Recount		Exposition		Persuasive		Narrative	
Measure	Grp	*M(SD)*	Range	*M(SD)*	Range	*M(SD)*	Range	*M(SD)*	Range
Coherence Local coherence	1	3.93 (.47)	2.33 – 4.78	3.55 (.62)	2.33 – 4.63	3.93 (.47)	3 – 4.90	4.33 (.39)	3.08 – 5
	2	3.94 (.33)	3.29 – 4.67	3.66 (.83)	1 – 5	3.79 (.48)	2.33 – 4.70	4.27 (.49)	2.88 – 5
	3	3.95 (.47)	2.71 – 5	3.50 (1.03)	0 – 5	3.77 (.48)	3 – 5	4.23 (.46)	3 – 5
	4	3.82 (.41)	2.50 – 4.50	3.77 (.64)	2.31 – 5	3.79 (.48)	2.60 – 4.71	4.10 (.50)	3.17 – 5
Global coherence	1	4.31 (.50)	2.99 – 5	4.11 (.54)	3.23 – 5	4.36 (.43)	3.51 – 5	4.83 (.20)	4.21 – 5
	2	4.33 (.41)	3.36 – 4.91	4.20 (.58)	2.71 – 5	4.39 (.38)	3.33 – 5	4.78 (.27)	3.93 – 5
	3	4.34 (.43)	3.38 – 5	4.09 (.62)	2.71 – 5	4.24 (.54)	3.20 – 5	4.73 (.39)	3.24 – 5
	4	4.22 (.40)	2.99 – 4.90	4.40 (.54)	2.86 – 5	4.43 (.53)	2.38 – 5	4.84 (.18)	4.30 – 5
Relevance % CIUs	1	77.96 (9.04)	48.44 – 94	78.03 (9.40)	58.89 – 92.26	82.8 (6.84)	68.85 – 93.59	86.82 (7.49)	61.42 – 95.26
	2	80.17 (7.01)	59.47 – 91.48	78.93 (8.89)	53.85 – 98.62	83.09 (6.16)	62.44 – 95.61	84.91 (6.99)	59.96 – 97.66
	3	79.57 (7.54)	64.26 – 95.50	75.69 (12.41)	43.60 – 93.48	80.51 (8.49)	62.11 – 93.73	85.32 (10.59)	47.37 – 96.62
	4	76.83 (7.71)	61.50 – 91.76	77.46 (8.62)	57.66 – 93.67	80.95 (9.94)	50.51 – 94.64	85.26 (6.82)	63.58 – 98.96
Efficiency CIUs per minute	1	98.23 (29.21)	24.16 – 147.46	88.99 (26.96)	34.57 – 159.13	120.03 (31.46)	54.55 – 186.41	124.71 (36.86)	53.92 – 217.96
	2	109.36 (32.38)	43.97 – 192.41	99.08 (30.75)	20.89 – 159.13	123.72 (31.20)	30.46 – 168.86	126.34 (35.46)	27.05 – 254.72
	3	103.78 (31.28)	46.00 – 168.39	92.49 (28.72)	44.57 – 152.31	116.37 (27.08)	47 – 165.32	120.71 (27.77)	55.18 – 166.88
	4	109.64 (21.32)	73.14 – 164.41	101.65 (23.72)	60 – 161.02	129.76 (27.34)	49.89 – 173.68	128.40 (32.66)	42.55 – 213.36

Note: Grp = Age groups (1 = 12-year-olds, 2 = 13-year-olds, 3 = 14-year-olds, 4 = 15-year-olds. CIU = Correct Information Units; %CIU = percent CIU of total words; CIUpm = total CIUs produced per minute of discourse.

Appendix H.4 Descriptive Statistics for Super-structural Variables across Genres and Age Groups

		Genre							
		Recount		Exposition		Persuasive		Narrative	
Measure	Group	*M(SD)*	Range	*M(SD)*	Range	*M(SD)*	Range	*M(SD)*	Range
Schema deviations	1	2.73 (1.81)	0 – 6	3.6 (11.75)	0 – 8	2.33 (1.47)	0 – 5	1.06 (1.39)	0 – 6
	2	3.04 (3.06)	0 – 19	3.36 (1.94)	0 – 9	2 (1.91)	0 – 9	1.48 (3.70)	0 – 26
	3	1.92 (1.49)	0 – 8	3 (1.99)	0 – 8	1.51 (1.39)	0 – 6	.95 (.99)	0 – 4
	4	2.74 (2.19)	0 – 10	3.63 (1.30)	1 – 6	2.13 (1.73)	0 – 8	.82 (.83)	0 – 3
Order deviations	1	.06 (.24)	0 – 1	.21 (.42)	0 – 1	.14 (.44)	0 – 2	.03 (.17)	0 – 1
	2	.14 (.35)	0 – 1	.32 (.59)	0 – 2	.24 (.59)	0 – 2	-	-
	3	.05 (.22)	0 – 1	.10 (.31)	0 – 1	.08 (.27)	0 – 1	-	-
	4	.11 (.39)	0 – 2	.26 (.50)	0 – 2	.16 (.55)	0 – 3	-	-
Genre shifts	1	-	-	.36 (.96)	0 – 5	-	-	-	-
	2	-	-	.32 (.71)	0 – 3	-	-	-	-
	3	-	-	.08 (.27)	0 – 1	-	-	-	-
	4	-	-	.18 (.56)	0 – 3	.05 (.32)	0 – 2	-	-
Restatements of question	1	.03 (.17)	0 – 1	.03 (.17)	0 – 1	-	-	-	-
	2	.10 (.30)	0 – 1	.10 (.30)	0 – 1	.02 (.14)	0 – 1	-	-
	3	.05 (.22)	0 – 1	.05 (.22)	0 – 1	-	-	-	-
	4	.11 (.31)	0 – 1	.05 (.23)	0 – 1	-	-	-	-

Note: Group = Age groups (1 = 12-year-olds, 2 = 13-year-olds, 3 = 14-year-olds, 4 = 15-year-olds); '-' = code did not present across sample.

Appendix H.5 Output of Follow-up Pairwise Comparisons (mean difference and p value) for Micro-linguistic variables.

CUDP-A variable	Genre (a)	Genre (b)	*Mean diff* (a-b)	*p*
Total words	Recount	Exposition	**130.17**	**.000**
		Persuasive	28.76	1.000
		Narrative	-14.71	1.000
	Exposition	Recount	**-130.17**	**.000**
		Persuasive	**-101.41**	**.013**
		Narrative	**-144.88**	**.000**
	Persuasive	Recount	-28.76	1.000
		Exposition	**101.41**	**.013**
		Narrative	-43.47	1.000
	Narrative	Recount	14.71	1.000
		Exposition	144.88	.000
		Persuasive	43.47	1.000
Total c-units	Recount	Exposition	**19.17**	**.000**
		Persuasive	**13.16**	**.000**
		Narrative	7.01	.205
	Exposition	Recount	**-19.17**	**.000**
		Persuasive	-6.01	.415
		Narrative	-12.17	.001
	Persuasive	Recount	**-13.16**	**.000**
		Exposition	6.01	.415
		Narrative	-6.16	.376
	Narrative	Recount	-7.01	.205
		Exposition	**12.17**	**.001**
		Persuasive	6.16	.376
NDW per 50 words	Recount	Exposition	3.83	.099
		Persuasive	-2.03	1.000
		Narrative	**-7.68**	**.000**
	Exposition	Recount	-3.83	.099
		Persuasive	**-5.86**	**.002**
		Narrative	**-11.51**	**.000**
	Persuasive	Recount	2.03	1.000
		Exposition	**5.86**	**.002**
		Narrative	**-5.65**	**.003**
	Narrative	Recount	**7.68**	**.000**
		Exposition	**11.51**	**.000**
		Persuasive	**5.65**	**.003**
%Maze Words	Recount	Exposition	**-0.04**	**.000**
		Persuasive	-0.01	.266
		Narrative	**0.03**	**.000**
	Exposition	Recount	**0.04**	**.000**
		Persuasive	**0.03**	**.000**
		Narrative	**0.07**	**.000**

CUDP-A variable	Genre (a)	Genre (b)	*Mean diff* (a-b)	*p*
	Persuasive	Recount	0.01	.266
		Exposition	**-0.03**	**.000**
		Narrative	**0.04**	**.000**
	Narrative	Recount	**-0.03**	**.000**
		Exposition	**-0.07**	**.000**
		Persuasive	**-0.04**	**.000**
MLUw	Recount	Exposition	**-0.79**	**.004**
		Persuasive	**-2.82**	**.000**
		Narrative	**-2.58**	**.000**
	Exposition	Recount	**0.79**	**.004**
		Persuasive	**-2.03**	**.000**
		Narrative	**-1.79**	**.000**
	Persuasive	Recount	**2.82**	**.000**
		Exposition	**2.03**	**.000**
		Narrative	0.24	1.000
	Narrative	Recount	**2.58**	**.000**
		Exposition	**1.79**	**.000**
		Persuasive	-0.24	1.000
Clausal Density	Recount	Exposition	**-0.19**	**.000**
		Persuasive	**-0.51**	**.000**
		Narrative	**-0.22**	**.000**
	Exposition	Recount	**0.19**	**.000**
		Persuasive	**-0.33**	**.000**
		Narrative	-0.04	1.000
	Persuasive	Recount	**0.51**	**.000**
		Exposition	**0.33**	**.000**
		Narrative	**0.29**	**.000**
	Narrative	Recount	**0.22**	**.000**
		Exposition	0.04	1.000
		Persuasive	**-0.29**	**.000**

Note: Bolded values indicate a significant difference

Appendix H.6 Output of Follow-up Pairwise Comparisons (mean difference and p value) for Micro-structural Variables

CUDP-A variable	Genre (a)	Genre (b)	*Mean diff* (a-b)	*p*
Cohesive frequency	Recount	Exposition	.20	1.000
		Persuasive	.07	1.000
		Narrative	**-1.06**	**.000**
	Exposition	Recount	-.20	1.000
		Persuasive	-.13	1.000
		Narrative	**-1.27**	**.000**
	Persuasive	Recount	-.07	1.000
		Exposition	.13	1.000
		Narrative	**-1.13**	**.000**
	Narrative	Recount	**1.06**	**.000**
		Exposition	**1.27**	**.000**
		Persuasive	**1.14**	**.000**
Cohesive adequacy	Recount	Exposition	-.79	1.000
		Persuasive	7.71	.061
		Narrative	**-28.87**	**.000**
	Exposition	Recount	.79	1.000
		Persuasive	**8.50**	**.028**
		Narrative	**-28.08**	**.000**
	Persuasive	Recount	-7.71	.061
		Exposition	**-8.50**	**.028**
		Narrative	**-36.58**	**.000**
	Narrative	recount	**28.87**	**.000**
		Exposition	**28.08**	**.000**
		Persuasive	**36.58**	**.000**

Note: Bolded values indicate a significant difference

Appendix H.7 Output of Follow-up Pairwise Comparisons (mean difference and p value) for Macro-structural variables.

CUDP-A variable	Genre (a)	Genre (b)	*Mean diff* (a-b)	*p*
Local Coherence	Recount	Exposition	**0.29**	**.000**
		Persuasive	0.08	1.000
		Narrative	**-0.33**	**.000**
	Exposition	Recount	**-0.29**	**.000**
		Persuasive	**-0.22**	**.005**
		Narrative	**-0.62**	**.000**
	Persuasive	Recount	-0.08	1.000
		Exposition	**0.22**	**.005**
		Narrative	**-0.40**	**.000**
	Narrative	Recount	**0.33**	**.000**
		Exposition	**0.62**	**.000**
		Persuasive	**0.40**	**.000**
Global Coherence	Recount	Exposition	0.10	.254
		Persuasive	-0.06	1.000
		Narrative	**-0.49**	**.000**
	Exposition	Recount	-0.10	.254
		Persuasive	**-0.16**	**.010**
		Narrative	**-0.59**	**.000**
	Persuasive	Recount	0.06	1.000
		Exposition	**0.16**	**.010**
		Narrative	**-0.43**	**.000**
	Narrative	Recount	**0.49**	**.000**
		Exposition	**0.59**	**.000**
		Persuasive	**0.43**	**.000**
% CIU	Recount	Exposition	1.11	1.000
		Persuasive	**-3.22**	**.005**
		Narrative	**-6.95**	**.000**
	Exposition	Recount	-1.11	1.000
		Persuasive	**-4.33**	**.000**
		Narrative	**-8.05**	**.000**
	Persuasive	Recount	**3.22**	**.005**
		Exposition	**4.33**	**.000**
		Narrative	**-3.73**	**.001**
	Narrative	Recount	**6.95**	**.000**
		Exposition	**8.05**	**.000**
		Persuasive	**3.73**	**.001**
CIUpm	Recount	Exposition	9.70	.027
		Persuasive	**-17.22**	**.000**
		Narrative	**-19.66**	**.000**
	Exposition	Recount	-9.70	.027
		Persuasive	**-26.92**	**.000**
		Narrative	**-29.36**	**.000**
	Persuasive	Recount	**17.22**	**.000**
		Exposition	**26.92**	**.000**
		Narrative	-2.44	1.000
	Narrative	Recount	**19.66**	**.000**
		Exposition	**29.36**	**.000**
		Persuasive	2.44	1.000

Note: Bolded values indicate a significant difference

Appendix H.8 Output of Follow-up Pairwise Comparisons (mean difference and p value) for Super-structural variables

CUDP-A variable	Genre (a)	Genre (b)	*Mean diff* (a-b)	*p*
Schema Deviations	Recount	Exposition	**-0.76**	**.005**
		Persuasive	0.59	.057
		Narrative	**1.53**	**.000**
	Exposition	Recount	**0.76**	**.005**
		Persuasive	**1.34**	**.000**
		Narrative	**2.28**	**.000**
	Persuasive	Recount	-0.59	.057
		Exposition	**-1.34**	**.000**
		Narrative	**0.94**	**.000**
	Narrative	Recount	**-1.53**	**.000**
		Exposition	**-2.28**	**.000**
		Persuasive	**-0.94**	**.000**
Order Deviations	Recount	Exposition	**-0.14**	**.007**
		Persuasive	-0.07	.623
		Narrative	0.09	.231
	Exposition	Recount	**0.14**	**.007**
		Persuasive	0.07	.623
		Narrative	**0.23**	**.000**
	Persuasive	Recount	0.07	.623
		Exposition	-0.07	.623
		Narrative	**0.16**	**.001**
	Narrative	Recount	-0.09	.231
		Exposition	**-0.23**	**.000**
		Persuasive	**-0.16**	**.001**
Genre Shifts	Recount	Exposition	**-0.24**	**.000**
		Persuasive	-0.01	1.000
		Narrative	0.00	1.000
	Exposition	Recount	**0.24**	**.000**
		Persuasive	**0.23**	**.000**
		Narrative	**0.24**	**.000**
	Persuasive	Recount	0.01	1.000
		Exposition	**-0.23**	**.000**
		Narrative	0.01	1.000
	Narrative	Recount	0.00	1.000
		Exposition	**-0.24**	**.000**
		Persuasive	-0.01	1.000
Restatements of Question	Recount	Exposition	0.01	1.000
		Persuasive	**0.07**	**.005**
		Narrative	**0.08**	**.002**
	Exposition	Recount	-0.01	1.000
		Persuasive	0.06	.038
		Narrative	**0.06**	**.015**
	Persuasive	Recount	-0.07	.005
		Exposition	-0.06	.038
		Narrative	0.01	1.000
	Narrative	Recount	**-0.08**	**.002**
		Exposition	**-0.06**	**.015**
		Persuasive	-0.01	1.000

Note: Bolded values indicate a significant difference

Appendix I Chapter 6 Appendices

Appendix I.1 Descriptive Statistics for Cognitive and Psychosocial Health Assessments

Assessment	all			12;0-12;11			13;0-13;11			14;0-14;11			15;0-;15;11		
	M	SD	CoV	*M*	SD	CoV	*M*	SD	CoV	*M*	SD	CoV	*M*	SD	CoV
CELF-4 NR	10.7	2.6	24.3	10.4	2.8	26.9	10.4	2.4	23.1	10.4	2.8	26.9	11.7	2.9	24.7
N-back	3.5	0.7	20.0	3.3	0.7	21.2	3.5	0.7	20.0	3.5	0.7	20.0	3.8	0.7	18.4
SST	255.8	103.5	40.5	245.4	79.3	32.3	258.0	88.7	34.4	272.5	126.9	46.6	245.0	114.6	46.8
Tower Test	1.8	0.5	27.8	1.9	0.5	26.3	1.8	0.5	27.7	1.8	0.5	27.8	1.8	0.4	22.2
Trail-making	43.7	36.5	83.5	61.0	63.5	104.1	40.5	24.1	59.5	38.4	19.2	50.0	38.3	27.2	71.0
Immediate	50.9	8.5	16.7	50.2	8.7	17.3	50.4	7.5	14.9	48.8	9.1	18.6	54.3	8.2	15.1
Delayed	11.3	2.7	23.9	11.1	2.4	21.6	11.4	2.8	24.6	10.5	2.9	27.6	12.1	2.6	21.5
BRIEF-2	18.8	4.5	23.4	**19.9***	3.8	19.1	19.4	4.3	22.2	19.4	5.1	26.3	**16.5***	3.9	23.6
LCQ	61.9	11.1	17.9	62.9	10.7	17.1	62.3	10.8	17.3	64.0	10.4	16.3	58.4	12.2	20.9
PQL SR Phys.	85.0	10.2	12.0	83.0	9.2	11.1	85.1	9.8	11.5	87.2	10.3	11.8	84.4	11.4	13.5
PQL SR Psych.	75.3	10.7	14.2	72.7	9.0	12.4	75.1	11.8	15.7	77.6	10.6	13.7	75.7	10.5	13.9
PQL SR Total	78.7	9.6	12.2	76.3	7.7	10.1	78.6	10.6	13.5	80.9	9.5	11.7	78.8	9.5	12.1
PQL PR Phys.	89.0	9.3	10.5	90.3	8.6	9.5	89.5	8.3	9.3	90.2	9.5	10.5	86.1	10.7	12.4
PQL PR Psych.	80.0	12.8	16.0	83.6	16.6	19.9	78.6	11.6	14.8	79.5	12.5	15.7	79.2	10.5	13.3
PQL PR Total	83.2	10.3	12.4	85.9	12.4	14.4	82.4	9.2	11.2	83.2	10.4	12.5	81.6	9.4	11.5
MFAD PS	1.6	0.4	25.0	1.6	0.4	25.0	1.6	0.4	25.0	1.7	0.4	23.5	1.6	0.4	25.0
MFAD Comm.	2.0	0.3	15.0	2.0	0.3	15.0	1.9	0.4	21.1	2.0	0.3	15.0	2.0	0.4	20.0
MFAD Roles	2.2	0.3	13.6	2.2	0.3	13.6	2.2	0.3	13.6	2.2	0.3	13.6	2.2	0.3	13.6
MFAD AR	1.8	0.4	22.2	1.8	0.4	22.2	1.8	0.4	22.2	1.8	0.4	22.2	1.8	0.5	27.8
MFAD AI	3.3	0.8	24.2	3.5	0.8	22.9	3.2	0.8	25.0	3.2	0.8	25.0	3.3	0.7	24.2
MFAD BC	2.5	0.6	24.0	2.7	0.7	25.9	2.4	0.6	25.0	2.6	0.7	26.9	2.5	0.7	28.0
MFAD GF	1.6	0.4	25.0	1.7	0.4	23.5	1.6	0.4	25.0	1.6	0.3	37.5	1.7	0.4	23.5
CASP	97.6	4.5	4.6	98.0	3.3	3.4	97.2	6.1	6.3	97.3	4.5	4.6	98.0	2.9	2.9

Note: CELF-4 NR = CELF-4 Number Repetition; SST = Stop-signal Task; Immediate = RAVLT Immediate; Delayed = RAVLT Delayed; Phys = physical; Psych = psychosocial; MFAD PS = Problem solving; Comm = Communication; AR/AI = Affective Involvement / Responsiveness; BC = Behaviour Control; GF = General Functioning. Bolded values are significantly different at the Bonferroni corrected alpha level * $p < .0125$ (.05/4).

Appendix I.2 Bivariate Correlations between Cognitive and Psychosocial Variables

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
1	1																						
2	$\mathbf{.26}^{***}$	1																					
3	-.07	-.14	1																				
4	-.13	$\mathbf{-.22}^{**}$	-.02	1																			
5	$\mathbf{-.17}^{*}$	-.15	-.01	.08	1																		
6	$\mathbf{.20}^{*}$	$\mathbf{.19}^{*}$	-.09	-.13	$\mathbf{-.17}^{*}$	1																	
7	.13	$\mathbf{.16}^{*}$	.03	-.05	-.07	$\mathbf{.60}^{***}$	1																
8	-.10	$\mathbf{-.17}^{*}$	.06	.13	.00	-.13	-.08	1															
9	-.13	.05	-.01	.01	.05	-.06	-.06	$\mathbf{-.22}^{**}$	1														
10	-.11	-.03	-.06	.02	-.07	-.01	-.01	$\mathbf{-.26}^{**}$	$\mathbf{.65}^{***}$	1													
11	-.13	.00	-.05	.02	-.03	-.03	-.03	$\mathbf{-.26}^{**}$	$\mathbf{.84}^{***}$	$\mathbf{.96}^{**}$	1												
12	-.10	-.04	.00	.02	.02	-.12	$\mathbf{-.16}^{*}$	$\mathbf{-.16}^{*}$	$\mathbf{.33}^{***}$	$\mathbf{.23}^{**}$	$\mathbf{.29}^{***}$	1											
13	.06	.13	-.08	.10	.02	.15	.04	$\mathbf{-.29}^{**}$	$\mathbf{.28}^{***}$	$\mathbf{.32}^{***}$	$\mathbf{.34}^{***}$	$\mathbf{.53}^{***}$	1										
14	.02	.09	-.06	.09	.02	.07	-.03	$\mathbf{-.28}^{**}$	$\mathbf{.33}^{***}$	$\mathbf{.33}^{***}$	$\mathbf{.36}^{***}$	$\mathbf{.75}^{***}$	$\mathbf{.96}^{***}$	1									
15	.07	-.07	-.01	.05	.12	-.05	-.01	$\mathbf{.20}^{*}$	$\mathbf{-.19}^{*}$	$\mathbf{-.27}^{***}$	$\mathbf{-.27}^{***}$	$\mathbf{-.22}^{**}$	-.11	$\mathbf{-.16}^{*}$	1								
16	-.11	.08	.10	.04	-.02	-.11	-.02	-.01	-.04	-.08	-.07	.07	-.04	.00	$\mathbf{.37}^{***}$	1							
17	.04	-.11	.05	.12	.07	-.11	-.13	.14	$\mathbf{-.27}^{***}$	$\mathbf{-.33}^{***}$	$\mathbf{-.34}^{***}$	$\mathbf{-.32}^{***}$	$\mathbf{-.21}^{**}$	$\mathbf{-.27}^{***}$	$\mathbf{.38}^{***}$	$\mathbf{.17}^{*}$	1						
18	.07	-.11	-.01	-.06	.01	-.03	-.02	.09	-.15	$\mathbf{-.22}^{**}$	$\mathbf{-.22}^{**}$	$\mathbf{-.20}^{*}$	$\mathbf{-.21}^{**}$	$\mathbf{-.23}^{**}$	$\mathbf{.55}^{***}$	$\mathbf{.35}^{***}$	$\mathbf{.33}^{***}$	1					
19	.00	-.09	-.13	.00	$\mathbf{.17}^{*}$	-.06	.03	$\mathbf{.25}^{**}$	$\mathbf{-.17}^{*}$	-.13	**-.16***	-.11	-.08	-.10	$\mathbf{.37}^{***}$	$\mathbf{.27}^{**}$	$\mathbf{.30}^{***}$	$\mathbf{.39}^{***}$	1				
20	.03	-.12	.01	.02	.09	-.05	.01	.08	-.09	-.08	-.10	-.02	.04	.02	$\mathbf{.35}^{***}$	$\mathbf{.29}^{***}$	$\mathbf{.25}^{**}$	$\mathbf{.39}^{***}$	$\mathbf{.51}^{***}$	1			
21	.01	-.07	-.06	-.02	$\mathbf{.16}^{*}$	-.03	.06	$\mathbf{.24}^{**}$	-.14	$\mathbf{-.20}^{*}$	$\mathbf{-.20}^{*}$	$\mathbf{-.16}^{*}$	-.14	$\mathbf{-.17}^{*}$	$\mathbf{.62}^{***}$	$\mathbf{.36}^{***}$	$\mathbf{.40}^{***}$	$\mathbf{.71}^{***}$	$\mathbf{.52}^{***}$	$\mathbf{.52}^{***}$	1		
22	.04	.13	$\mathbf{-.17}^{*}$	-.12	-.08	$\mathbf{.21}^{**}$	.10	$\mathbf{-.29}^{***}$	.15	$\mathbf{.26}^{***}$	$\mathbf{.25}^{**}$	$\mathbf{.28}^{***}$	$\mathbf{.34}^{***}$	$\mathbf{.36}^{***}$	$\mathbf{-.20}^{*}$	.04	$\mathbf{-.38}^{***}$	-.15	-.09	-.15	$\mathbf{-.25}^{**}$	1	
23	-.06	.08	.06	.01	-.05	-.08	-.01	$\mathbf{.36}^{**}$	$\mathbf{-.18}^{*}$	$\mathbf{-.24}^{**}$	$\mathbf{-.24}^{**}$	.03	-.02	-.01	.12	.13	.00	$\mathbf{.18}^{*}$	.15	.13	.11	-.09	1

Note: 1 = CELF-4 Number repetition; 2 = N-back; 3 = stop-signal, 4= Tower Test, 5 = Trail-making, 6= RAVLT Immediate, 7 = RAVLT Delayed, 8 = BRIEF-2, 9 = PedsQL SR Physical, 10 = PedsQL SR Psychosocial; 11 = PedsQL SR Total; 12 = PedsQL PR Physical, 13 = PedsQL PR Psychosocial, 14 = PedsQL PR Total, 15 = MFAD Problem, 16 = MFAD Communication, 17 = MFAD Roles, 18 = MFAD Affective Resp; 19 = MFAD Affective Invol. 20 = MFAD Behaviour 21 = MFAD General Func. 22 = CASP Total, 23 = LCQ. Bolded values are significant at *** $p<.001$, ** $p<.01$, * $p<.05$.

Appendix I.3 Three-factor Solution for Cognitive PCA with Varimax Rotation

	Factor		
Cognitive variable	1	2	3
RAVLT Delayed	.910		
RAVLT Immediate	.861		
BRIEF-2 Parent Screen		.652	
N-back task*		-.594	.405
D-KEFS Tower Task		.557	
Stop-signal Task		.410	
D-KEFS Trail-making Test			-.820
CELF-4 Number Repetition*		-.325	.563

* Variables that would need to be removed due to cross-loadings <.3 (Tabachnik & Fidell, 2007).

Appendix J Chapter 7 Appendices

Appendix J.1 Curtin HREC-Approved Project Flyer for Recruitment of Adolescents with ABI

Communication after Acquired Brain Injury

Curtin University

Help us understand the impact of brain injury on communication.

We know that people who have had a brain injury can find it difficult to talk the way they used to with family, friends, and teachers. For example, they might find themselves going off topic, or losing track of conversation.
A PhD student at Curtin University is conducting research* on the effect that brain injuries can have on how people communicate at home, school, and out in the community.

The project will look at:

- The difference between the way children and adolescents with and without brain injuries talk.
- Whether these differences have something to do with other skills that allow us to communicate, such as memory and attention.
- Whether these differences occur across different types of communication. For example, telling a parent what happened at school versus explaining the rules of a game to a friend.
- How difficulty communicating impacts emotional wellbeing and participating with friends and family.

What is involved?

Participation involves completing a variety of tasks with a qualified speech pathologist. These tasks will look at language and communication, as well as other skills needed for everyday communication. The tasks will involve answering questions, talking, and solving puzzles. The tasks will be completed over **two 45-60 minute sessions** either at your home or at Curtin University. You will receive a Hoyts **movie voucher** to thank you for your time!

How will this study help my child and/or the community?

You and/or your parents will receive a detailed summary of your, or your child's performance across each area of assessment, including communication skills and other processes that are required for communication. This may also identify areas in which you or your child requires further support.

Who should I contact?

If you are interested or have any questions, please contact Lizz Hill on 0437 514 025, or by email at elizabeth.j.hill@postgrad.curtin.edu.au

Your response is greatly appreciated!

*Ethics approval obtained from Curtin University.

Appendix J.2 Curtin HREC-approved Information Sheet and Consent Form for Recruitment of Adolescents with ABI

School of Occupational Therapy, Social Work, and Speech Pathology
Curtin University
GPO Box U 1987, Perth
Western Australia, 6845

Spoken Communication following School-age Acquired Brain Injury
Parent Information Sheet and Consent Form

Dear Parent,

My name is Elizabeth Hill and I am a PhD student at Curtin University. My project is exploring the impact of brain injury on how teenagers talk in everyday situations, for example telling a story, having a conversation with friends or explaining how to play a game. This project will help Speech Pathologists working with teenagers who have a history of brain injury, to provide more effective assessment and treatment.

What does participation in the research project involve and are there any risks?

If you would like your child to take part in this research, I will assess their communication, attention, and memory skills. I will also ask you and your child to complete some questionnaires about your child's interaction with friends and family, and how they feel in different situations. Your child will see me for two **45-60 minute** sessions. These can be done at home or at Curtin University, whichever best suits you. Details on the tasks that your child will complete are provided on the document called, "*Parent Information Sheet: Assessment Details".*

Each task will be completed once. Your child will be audio-recorded on one task so that their answers can be measured at a later time. There are **no foreseeable risks** or side effects associated with taking part in this project. The tasks your child will complete are similar to those used by Speech Pathologists working with children and teenagers.

Does my child have to take part?

Participation in this research is voluntary. Your child does not have to take part if you do not want them to. If you would like your child to take part, I have included a consent form for you to sign. I have also included a consent form for your child. Please talk to your child about the activities and let them know that they do not need to take part if they do not want to.

What if either of us was to change our mind?

If you have agreed to take part, but then change your mind, you may withdraw your child, or your child may withdraw themselves at any time without consequence. If your child is withdrawn from the study, all of your child's information will be destroyed immediately.

What will happen to the information collected, and is privacy and confidentiality assured?

When information is collected about your child, their name and any personal information will be removed. Your child will be given a unique code. Your child's information is stored this way so that, if you decide to take part and then withdraw from the project, we can find your child's information and destroy it.

The results of this project may be published, but no personal information about your child will be used. Your child's name or details will not be given to anyone. However, this information may be provided in a situation where the research team must legally report this information, according to the Department of Education Child Protection Policy.

The hardcopy assessment record forms and audio-files will be stored in a secure filing cabinet at Curtin University and only specific staff involved in this project will have access. The audio recordings of your child will only be used as part of the assessments for this study. Records will be kept for 7 years or until the child reaches 25 years of age, and then destroyed.

What are the benefits of this research for my child?

The results of this project will help Speech Pathologists better understand the impact of acquired brain injury on communication in children and adolescents. We hope this project will help the development effective treatments, as a result, change the way in which speech pathologists treat communication difficulties. In addition, you can receive a summary of your child's results on the standardised assessments of language, attention, and memory if you wish to do so. You will receive your child's results on the questionnaires of participation and emotional wellbeing if they indicate cause for concern. Finally, your child will receive a **movie voucher** to thank them for their time.

How do I know that the people involved in this research have all the appropriate documentation to be working with children?

Under the Working with Children (Criminal Record Checking) Act 2004, researchers that work with children must pass a Working with Children Check. I will provide you with a copy of my Working with Children check at the beginning of the first assessment session.

Is this research approved?

Approval has been received from the Curtin University Human Research Ethics Committee (HRE2016-0219**)**. Any questions or verification of approval for this study can be obtained by contacting the Committee. Address: Curtin University Human Research Ethics Committee, c/- Office of Research and Development, Curtin University, GPO Box U1987, Perth, 6845.

Telephone: 9266 9223. Email: hrec@curtin.edu.au

What if I have further questions about this research project?

Please do not hesitate to contact me or any member of the research team if you have any questions about the project. I can be contacted by email at Elizabeth.j.hill@postgrad.curtin.edu.au. You may also wish to contact members of the research team, Dr. Mary Claessen (m.claessen@curtin.edu.au) or 9266 3472, Associate Professor Anne Whitworth (anne.whitworth@curtin.edu.au) and Dr. Mark Boyes (mark.boyes@curtin.edu.au).

How do I indicate my willingness for the school to be involved in this project?

If you have read the above information carefully and have had all questions about the research project answered to your satisfaction, and are willing for your chill to participate, please complete the **Consent Form** attached. If you would like to be involved, please post this form to: School of Occupational Therapy, Social Work, and Speech Pathology, Curtin University GPO Box U 1987, Perth, Western Australia, 6845. Alternatively, you can sign and return the form via email to elizabeth.j.hill@postgrad.curtin.edu.au.

Regards,
Elizabeth Hill

This study has been approved by the Curtin University Human Research Ethics Committee (Approval HRE2016-0219). The committee is comprised of members of the public, academics, lawyers, doctors and pastoral carers. If needed, verification of approval for this study can be obtained by contacting the Committee: Curtin University Human Research Ethics Committee, c/- Office of Research and Development, Curtin University, GPO Box U1987, Perth, 6845. Telephone: 9266 9223, Email: hrec@curtin.edu.au.

Spoken Communication following School-age Acquired Brain Injury

Parent Consent Form

| | I have read this document and I understand the aims, procedures, and risks of this project.

| | I have been given the opportunity to ask any questions, and these have been answered.

| | I am willing for my child to become involved in the research project, as described.

| | I have talked to my child about the project, and he/she wishes to take part, as indicated by his /her completion of the child consent form.

| | I understand that participation in this project is completely voluntary.

| | I understand that both my child and I are free to withdraw from participation at any time without consequence

| | I give permission for the contribution that my child makes to this research to be used in conference talks and published in a journal, provided that my child is not identified in any way.

| | I understand that a summary of findings from the research can be made available to me and my child upon its completion.

| | I understand that this summary will contain the results of standardised language, attention, and memory tasks. I will only receive the results of emotional wellbeing and participation tasks if results indicate cause for concern.

| | I understand that my child's responses on language, cognitive and daily life tasks will be audio recorded to allow scoring and further analysis to take place.

| | I understand that I may be contacted via phone and email at a time convenient to me to complete questionnaires as part of my involvement in this project.

| | I would like to be provided with a summary of my child's (please provide your address).

____

____

____

Name of Child (please print): ________________________________ _ ____

Date of birth (please print): _____ / _____ / ________

Name of Parent (plea se print): ________________________________ ______

Phone (parent): ____________________________________

Email (parent): ____________________________________

Signature of Parent/Carer: ____________________________________

Date (DD/MM/YYYY): _____ / _____ / ________

School of Occupational Therapy, Social Work, and Speech Pathology

Curtin University
GPO Box U 1987, Perth
Western Australia, 6845

Spoken Communication following School-age Acquired Brain Injury

Participant Information Sheet and Consent Form

Dear Student,

My name is Elizabeth Hill and I am a Speech Pathologist and student at Curtin University. I'm interested in how brain injuries can change the way children and teenagers talk. In this study, I want to see how you communicate during activities that you may do every day, for example telling a story, telling a friend how to play a game, or telling your parent(s) what happened at school. When this study is finished it will help speech pathologists who work with school students who have had injuries to improve the way they communicate at home and at school with friends and family.

What we are asking you to do:

If you want to be involved, you will complete **two 45-60 minute** sessions at your home or at Curtin University. During these sessions, you will do a variety of language, attention, and memory activities. Some of these activities are on the computer; others are using a pen and paper. Your answers on some tasks will be audio-recorded so I can listen to things that you say later.

Do I have to be involved?

You do not have to be involved in this study. It is up to you. You can say no now or you can even change your mind later. No one will be upset with you if you decide not to be in this study.

Your marks at school and your relationships with parent and teachers will not change if you decide you do not want to take part OR if you choose to stop at any time.

Will being in this study hurt or help me in any way?

Being in this study will not hurt you in any way. You will probably enjoy most of the tasks and activities and you will be helping speech pathologists better understand what happens to talking after brain injury. I hope this study will help Speech Pathologists improve communication skills in teenagers who have had a brain injury.

What will you do with information about me?

I will be very careful to keep your answers and tape recording private. Before and after the study I will keep all information, I collect locked up and password protected at my University. When other people look at my study they will not know which information is yours. If you want to stop doing the study, email me at elizabeth.j.hill@postgrad.curtin.edu.au or call my supervisor, Mary, on 9266 3472. If you decide to stop coming to sessions before I have finished the study, all the information you have given me will be destroyed. There is no punishment for deciding to stop doing the study. If you decide that you don't want your information in the study after I have finished, just let me know and contact me on the above number and email address.

What if I have a question about the study?

If you have any questions about the study, please contact Elizabeth Hill or a member of the research team. Their emails are below: Elizabeth Hill – Elizabeth.j.hill@postgrad.curtin.edu.au (Speech pathologist and PhD student) Dr. Mary Claessen – m.claessen@curtin.edu.au (Speech pathologist and supervisor), Associate Professor Anne Whitworth - anne.whitworth@curtin.edu.au (Speech pathologist and supervisor) or Dr. Mark Boyes –.mark.boyes@curtin.edu.au (Psychologist and supervisor)

Agreement:
By signing this form, I agree to be in the research study described above.

Name: ____

Signature: ____ Date:
____

This study has been approved by the Curtin University Human Research Ethics Committee (Approval HRE2016-0219). The committee is comprised of members of the public, academics, lawyers, doctors and pastoral carers. If needed, verification of approval for this study can be obtained by contacting the Committee: Curtin University Human Research Ethics Committee, c/- Office of Research and Development, Curtin University, GPO Box U1987, Perth, 6845. Telephone: 9266 9223, Email: hrec@curtin.edu.au.

Appendix J.3 DL Scores for CUDP-A Variables compared to 12-year-old Reference Sub-group (bolded values indicate significant comparisons)

Measure	All			Recount			Exposition			Persuasive			Narrative		
	Ref M(SD)	DL	*p*	Ref M(SD)	DL	*p*	Ref M(SD)	DL	*p*	Ref M(SD)	DL	*p*	Ref M(SD)	DL	*p*
Micro-linguistic															
C-units	118.9 (91.7)	59	.261	39.8 (43.1)	23	.332	21.1 (23.6)	10	.322	24.0 (14.3)	14	.247	33.8 (28.1)	11	.214
NDW	442.2 (197.5)	280	.211	119.2 (75.6)	**99**	**.021**	83.7 (52.8)	47	.248	104.5 (40.1)	80	.274	137.4 (63.5)	54	.109
Mazes	67.7 (82.1)	8	.239	22.2 (37.6)	1	.356	15.6 (25.9)	2	.304	16.7 (14.9)	2	.168	13.1 (17.1)	3	.281
%Maze words	9.6 (4.5)	2	.051	9.2(4.8)	1	.073	12.4 (7.9)	3	.431	10.2 (5.0)	**1**	**.038**	6.7(5.9)	3	.269
MLUw	9.2(1.0)	8.3	.189	7.5(1.1)	7.8	.239	8.6 (1.9)	6.3	.119	10.5 (2.1)	10.3	.463	10.3 (1.7)	8.6	.164
Clausal density	1.4(.2)	**1**	**.026**	1.1(.3)	1.1	.371	1.4(.3)	**0.9**	**.049**	1.7(.5)	1.1	.121	1.3(.2)	1.3	.164
Micro-structural															
Total ties	77.9 (60.0)	24	.190	23.4 (26.3)	7	.491	11.2 (12.7)	3	.264	14.5 (10.2)	5	.181	77.9 (60.0)	1	.170
Cohesive adequacy	69.3 (14.2)	53	.132	61.6 (20.4)	14.3	.339	68.1 (30.6)	100	.154	55.7 (26.2)	**0**	**.049**	69.3 (14.2)	100	.304
Macro-structural															
Local coherence	4.0(.3)	**3.2**	**.006**	3.9(.5)	2.2	.087	3.6(.6)	4.3	.128	3.9(.5)	2.8	.217	4.3(.4)	**3.4**	**.016**
Global coherence	4.4(.3)	**3.6**	**.006**	4.3(.5)	3.6	.087	4.1(.5)	**2.6**	**.002**	4.4(.4)	**3.4**	**<.001**	4.8(.2)	4.7	.312
%CIU	81.4 (5.9)	77.3	.248	78.0 (9.0)	64.5	.469	78.0 (9.4)	76.9	.454	82.9 (6.8)	87	.195	86.8 (7.5)	80.5	.206
CIUpm	107.9 (25.0)	**47.2**	**.010**	98.2 (29.2)	42	**.044**	89.0 (27.0)	55.6	.114	120 (31.5)	**56.9**	**.025**	124.7 (36.9)	**34.3**	**.010**
Super-structural															
Schema deviation	9.7(4.1)	7	.257	2.7(1.8)	3	.435	3.6 (1.8)	3	.371	2.3(1.5)	0	.324	1.1(1.4)	0	.221
Order deviation	.5(.8)	0	.289	.1(.2)	**1**	**<.001**	.2(.4)	0	.312	.2(.4)	0	.312	0(.2)	0	.500
Genre shift	.4(1.0)	1	.260	0(0)	0	n/a	.4(.1)	1	.347	0(0)	0	n/a	0(0)	0	n/a
RSQ	.1(.2)	0	.403	0(.2)	**0**	**<.001**	0(.2)	0	.500	0(0)	0	n/a	0(0)	0	n/a

Appendix J.4 HB Scores for CUDP-A Variables compared to 14-year-old Reference Sub-group (bolded values indicate significant comparisons)

Measure	All			Recount			Exposition			Persuasive			Narrative		
	Ref M(SD)	HB	*p*	Ref M(SD)	HB	*p*	Ref M(SD)	HB	*p*	Ref M(SD)	HB	*p*	Ref M(SD)	HB	*p*
Micro-linguistic															
C-units	103.5 (67.5)	100	.479	31.7 (31.9)	66	.148	18.9 (14.6)	9	.254	25.9 (22.5)	20	.399	27.2 (17.1)	5	.104
NDW	405.3 (192.6)	360	.257	102.0 (64.1)	181	.115	78.9 (50.1)	62	.370	103.3 (64.0)	82	.372	121.1 (56.6)	35	.070
Mazes	61.8 (55.9)	61	.477	15.7 (17.4)	34	.154	15.6 (13.2)	10	.339	18.3 (20.1)	13	.398	12.2 (18.1)	4	.329
%Maze words	10.3 (4.4)	**0.1**	**.013**	9.3 (4.7)	11	.361	14.9 (7.6)	12	.354	10.9 (4.7)	14	.259	6.1 (5.8)	7	.439
MLUw	9.1 (1.2)	8.7	.372	7.5 (1.6)	7	.379	8.3 (1.9)	9.4	.285	10.1 (2.3)	8.5	.248	10.7 (2.6)	10	.396
Clausal density	1.3(.1)	1.4	.164	1.1(.2)	1.2	.312	1.3(.2)	1.4	.312	1.6(.3)	1.8	.257	1.3(.2)	1.2	.312
Micro-structural															
Total ties	68.9 (45.8)	46	.312	17.1 (20.1)	31	.248	11.7 (11.5)	5	.284	16.7 (14.6)	8	.279	23.3 (15.3)	2	.088
Cohesive adequacy	63.6 (20.0)	72.2	.337	59.1 (24.1)	58.1	.484	56.7 (37.9)	80	.273	50.3 (30.9)	50	.496	88.6 (23.2)	100	.315
Macro-structural															
Local coherence	3.9 (.5)	3.2	.087	4.0 (.5)	**3.1**	**.041**	3.5 (1.0)	3	.312	3.8 (.5)	3	.061	4.2 (.5)	3.6	.122
Global coherence	4.4 (.4)	**3.5**	**.016**	4.3 (.4)	3.7	.073	4.1 (.6)	**2.9**	**.028**	4.2 (.5)	**3.3**	**.041**	4.7 (.4)	5	.232
%CIU	80.3 (7.2)	80.7	.478	79.6 (7.5)	78.6	.448	75.7 (12.4)	86	.208	80.5 (8.5)	71.2	.143	85.3 (10.6)	85.7	.485
CIUpm	108.3 (21.4)	135.2	.111	103.7 (31.3)	121.2	.292	92.5 (28.7)	129	.108	116.4 (27.1)		.481	120.7 (27.8)	**172.9**	**.036**
Super-structural															
Schema deviation	7.4(3.6)	**19**	**.002**	1.9(1.5)	**9**	**<.001**	3.0(2.0)	5	.165	1.5(1.4)	3	.148	1.0(1.0)	2	.165
Order deviation	.2(.4)	**1**	**.043**	.1(.2)	**1**	**<.001**	.1(.3)	**1**	**<.001**	.1(.3)	0	.371	0(0)	0	n/a
Genre shift	.1(.3)	0	.386	0(0)	0	n/a	.1(.3)	0	n/a	0(0)	0	n/a	0(0)	0	n/a
RSQ	.1(.4)	**1**	**.012**	.1(.2)	**1**	**<.001**	.1(.2)	0	.312	0(0)	0	n/a	0(0)	0	n/a

Appendix J.5 DL and HB Scores for Genre-specific Super-structural Variables and Comparisons to M(SD) of Age-matched Reference Sub-group (bolded values indicate significant comparisons)

	Participant					
Schema component	12 M(SD)	DL	*p*	14 M(SD)	HB	*p*
Recount						
Orientation to character	2.5(.77)	**0**	**<.001**	2.7(0.5)	3	.298
Orientation to location	1.4(.7)	**0**	**.028**	1.4(0.7)	**0**	**.028**
Orientation to time	1.4(.9)	0	.071	1.3(0.9)	2	.253
Orientation to other	1.0(.8)	1	.480	0.8(0.5)	0	.119
Initiating event	.2(.4)	**1**	**.024**	0.2(0.4)	0	.309
Event	17.1(12.9)	9	.267	14.1(12.0)	24	.297
Elaborations of detail	6.9(8.4)	8	.449	5.8(8.8)	9	.403
Evaluations	2.9(3.6)	0	.212	2.6(4.0)	5	.274
Conclusion	.2(.5)	0	.313	0.2(0.4)	0	.313
End marker	.83(.9)	0	.179	1.0(1.0)	0	.179
Exposition						
Thesis	2.0(1.0)	**0**	**.022**	2.0(1.0)	1	.160
Sub-category	5.8(4.2)	0	.081	5.3(4.7)	3	.249
Elaborations of detail	2.8(3.1)	0	.182	2.5(2.9)	0	.182
Evaluation	.8(1.3)	0	.271	0.6(1.6)	0	.271
Conclusion	.1(.2)	0	.411	0(0.2)	0	.411
End marker	1.1(1.0)	0	.157	1.2(1.1)	0	.157
Persuasive						
Thesis / opinion	2.5(.7)	3	.235	2.4(0.8)	**1**	**.023**
Supporting argument	5.8(2.5)	2	.071	5.3(2.3)	5	.383
Counter argument	1.1(1.2)	0	.194	1.2(1.5)	0	.194
Elaboration	4.0(2.8)	1	.139	3.5(3.0)	2	.233
Evaluation	.6(1.1)	0	.288	0.5(1.1)	1	.349
Conclusion	.8(.9)	0	.187	0.6(0.9)	0	.187
End	.5(.8)	0	.255	0.8(0.9)	0	.255
Narrative						
Orientation to character	2.2(.7)	2	.398	2.1(0.7)	3	.135
Orientation to location	.6(.6)	0	.192	0.5(0.6)	0	.192
Orientation to time	.4(.6)	0	.264	0.3(0.5)	0	.264
Orientation to other	.3(.5)	0	.297	0.3(0.5)	0	.297
Initiating event	1.8(.8)	2	.390	1.6(0.8)	2	.390
Events	17.0(14.2)	5	.271	13.9(10.6)	3	.271
Response/Plan	.4(.6)	0	.199	.2(.6)	0	.199
Reflective comments	.7(1.3)	0	.289	0.4(0.8)	0	.289
Elaborations of detail	.9(1.4)	0	.260	0.6(0.9)	0	.260
Conclusion	.7(.7)	1	.358	0.4(0.6)	0	.163
End marker	.7(.8)	0	.186	0.7(0.8)	0	.186

Appendix J.6 DL and HB Scores for Oral Language, Cognitive, and Psychosocial Health Assessments and Comparisons to Age-matched Reference Subgroups (bolded values indicate significant comparisons).

Assessment	12;0-12;11 M(SD)	DL	*p*	14;0-14;11 M(SD)	HB	*p*
Oral language						
CELF-4 Core Language Score		**93**	**.037**		103	.087
Cognitive function						
CELF-4 Number Repetition	3.3(0.7)	**6**	.062	3.5(0.7)	8	.203
N-back		**2.3**	.076		2.5	.092
Stop-signal Task	245.4(79.3)	**456.4**	**.007**	272.5(126.9)	295.6	.439
Tower Test	1.9(0.5)	**2.8**	**.031**	1.8(0.5)	2.4	.109
Trail-making	61.0(63.5)	129.7	.157	38.4(19.2)	**284.1**	**<.001**
BRIEF-2 Screen	19.9(3.8)	**28**	**.022**	19.4(5.1)	25	.140
RAVLT Immediate	50.2(8.7)	39	.106	48.8(9.1)	46	.382
RAVLT Delayed	11.1(2.4)	**6**	**.021**	10.5(2.9)	11	.433
Psychosocial health						
LCQ	62.9(10.7)	80	.063	64.0(10.4)	49	.081
PedsQL SR Physical	83.0(9.2)	**56.3**	**.004**	87.2(10.3)	**37.5**	**<.001**
PedsQL SR Psychosocial	72.7(9.0)	**56.7**	**.040**	77.6(10.6)	**51.7**	**.011**
PedsQL SR Total	76.3(7.7)	**56.5**	**.008**	80.9(9.5)	**46.7**	**<.001**
PedsQL PR Physical	90.3(8.6)	**62.5**	**.002**	90.2(9.5)	**31.3**	**<.001**
PedsQL PR Psychosocial	83.6(16.6)	**56.0**	.057	79.5(12.5)	**41.7**	**.002**
PedsQL PR Total	85.9(12.4)	**64.1**	**.046**	83.2(10.4)	**38.0**	**<.001**
MFAD Problem-solving	1.6(0.4)	2.2	.095	1.7(0.4)	2.0	.185
MFAD Communication	2.0(0.3)	2.2	.261	2.0(0.3)	2.2	.188
MFAD Roles	2.2(0.3)	2.1	.412	2.2(0.3)	2.6	.067
MFAD Affective Responsiveness	1.8(0.4)	2.3	.193	1.8(0.4)	2.0	.352
MFAD Affective Involvement	3.5(0.8)	4.0	.237	3.2(0.8)	3.9	.191
MFAD Behaviour control	2.7(0.7)	3.4	.137	2.6(0.7)	3.0	.254
MFAD General functioning	1.7(0.4)	2.1	.197	1.6(0.3)	1.8	.248
CASP	98.0(3.3)	**68.8**	**<.001**	97.3(4.5)	**68.8**	**<.001**