School of Occupational Therapy, Social Work and Speech Pathology

Faculty of Health Science

Acquisition of Phonology in a Creole Tok Pisin-Speaking Population of Highlands Children, Papua New Guinea: A Preliminary Study

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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 2017. The proposed research study received human research ethics approval from the Curtin University Human research Ethics committee, approval number RDHS-85-15.

Signed

Jennifer Margaret Boer

Abstract

Purpose: This cross-sectional study describes the acquisition of phonology in multilingual Tok Pisin-speakers of the highlands of Papua New Guinea (PNG). It tested the hypothesis that phonological inventories would increase with age in 80 children aged between 3; 0 and 6; 11 years in four equal 12 month age bands. It examined if phonological development would reflect universal principles and if there were differences between the phonological acquisition of boys and girls.

Method: A pilot study (N=12) confirmed the adult models for relational phonological measures. A child pilot (N=17) informed development of an appropriate word naming task. The cross sectional study sampled 80 children for each year group from communities near Mt Hagen, PNG. Independent measures included phonetic and phonotactic inventories. Relational measures were phonological and developmental process inventories. The Percentage Consonants Correct (PCC) measures were analysed statistically.

Results: Both phonetic and phonological inventories reflected age differences and universal features. Inventories and processes also displayed language-specific features. Variation within age groups reflected children's complex language experience. Universal features included early acquisition of plosives. Language-specific features included early acquisition of affricate /ʤ/ and fricatisation. Phonological development of boys and girls showed no statistically significant differences.

Conclusion: PNG Tok Pisin speakers' consonant acquisition reflects a complex interplay between universal tendencies, substrate influences and the creolising influence of English.

Keywords: Tok Pisin, phonological, universals, creole.

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As lead author, I was primarily responsible for study conception and design of the research question, with contribution from Associate Professor Williams. I was primarily responsible for participant recruitment, data collection and preparation. I was also predominantly responsible for interpretation, discussion and writing the manuscript. My co-author contributed significantly to conception and study design and was involved in interpretation of the finding, editing of the manuscript and provided final approval prior to submission.

Supervisor Associate Professor Cori Williams

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Student Jennifer Margaret Boer

Signature

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Table of Contents

List of Tables

List of Figures

Chapter 1. Introduction

This study is set in Papua New Guinea (PNG), an island nation of the Pacific Ocean region, Australia's northern neighbour and former protectorate. Specifically, the study took place in the Western Highlands Province (WHP), in and around its largest city, Mt Hagen.

PNG is the most linguistically diverse nation on earth with 841 languages, 838 of which are vernacular languages (Simons & Fennig, 2018). Although there is a rich history of both academic and mission linguistic study in PNG, there has not yet been a focus on clinical linguistic studies to support people living with communication disorders. PNG does not have any government Speech and Language Pathology (SLP) services or any documented history of SLP services or research in the country. Medical and educational services in the Highlands region have a brief history, dating from the arrival of white colonisers in the 1930s. Therefore, planning for provision of SLP services in PNG involves logistical and theoretical considerations. Whilst undertaking eight years volunteer service as a Speech Language Pathologist (SLP), the author saw the need to begin preliminary research to underpin SLP services in PNG. SLP resources that will support clinical needs, and which are tailored to the country's needs must be created. Developmental language and phonological studies are needed to provide an understanding of the speech and language system.

The principal languages of PNG are English, the *Language of Wider Communication* (LWC)(Fishman, 1969) and Tok Pisin, the largest indigenous *lingua franca* in PNG. This study set out to begin SLP research in PNG with a preliminary cross-sectional study of children's phonological acquisition of Tok Pisin.

1.1 Outline of Thesis

The challenge to developmental phonological research in PNG at this juncture is the lack of precedent in the country. This necessitates careful consideration of factors found in this complex sociolinguistic setting. These factors must be balanced with what has been learnt in research in other parts of the world which have a longer history of developmental and clinical linguistic research.

The literature review in chapter 2 begins by exploring theoretical themes in research into phonological development. Theory underlying the universal features of languages, patterns of markedness and the developmental phonological processes children employ as their phonology develops, are discussed with reference to cross-linguistic studies. The complexities of multilingual phonological acquisition are then explored. Following this, pidgin and creole languages are described in order to clarify the further complexities which occur in phonological acquisition when a contact language is included. The role of gender in language development is touched on prior to a discussion of appropriate measures for phonological research in the multilingual majority world, with reference to PNG.

Chapter three provides the linguistic and cultural setting of the study. It begins with an introduction to the geographic and political setting of PNG. An exploration follows of the complex and dynamic interface between the three types of language and their phonologies in PNG: vernacular languages, English, and the lingua franca; Tok Pisin (TP). It describes the grammar, phonology and sociolinguistic profile of TP and outlines the reasons for choosing TP for this preliminary study. The history of non-developmental research in TP is touched on briefly. The phonology and usage of Melpa, the vernacular mother-tongue language of participants, is outlined. Following this, the cultural context of PNG, and the

importance of the project are discussed. This leads into the research questions and hypotheses.

The preliminary steps in the research were the adult and child pilot studies. These are presented in chapter four, as they contribute to the content, targets and development of the naming tool used in the child study proper. The pilot study of adult TP phonological use profiles TP phonology from the literature and describes the method, results and the resultant adult TP phonological targets for the child cross-sectional study. Chapter four also describes the child pilot study, which involved the development and trial of the data-collection tool. This section encompasses the cultural considerations implicit in providing a clinical measure applicable to this setting. The methodology for the cross-sectional child study is described in chapter five followed by the results in chapter six and the overall discussion in chapter seven.

Chapter 2. Models of Phonological Acquisition

The child's acquisition of a mature phonology first requires them to be able to perceive and physically produce the sounds of their language, that is, to acquire their phonetic inventory. As well as mastering the physical articulation of sounds, the child must also learn how to use those sounds to carry meaning. This occurs through development of their phonological system, which reflects the structure of the contrasts and phonotactic rules which constitute the phonology of their language (Burquest, 2006; Stoel-Gammon, 1985).

Phoneticians use descriptive parameters derived from the physical reality of the vocal tract and articulators to categorise speech segments. Sounds can be grouped together according to *features* of voicing, manner and place (Stoel-Gammon, 1985). These *distinctive features* allow sounds to be described and categorised into groups based on shared features.

There is a rich seam of English language research that has flourished since the 1970s, studying developmental phonology from a clinical perspective (Stoel-Gammon, 1985). Prior to this, most research was motivated by theoretical rather than clinical goals and was structural or typological. The pioneer work of structural theorist Jakobson(1968) from the Prague school of linguistics, is still referred to frequently. Jakobson introduced several foundational concepts to describe phonological development (Durand & Prince, 2016) which he saw as occurring in a universal pattern.

Jakobson proposed that phonemes, as the linguistic units of speech structure, are defined by their distinctive features (Jakobson, 1968). He emphasised the physiologically determined, binary nature of early phonological oppositions or contrastive features. He observed that distinctions between these segments move

from gross differences, such as the differentiation between vowels and consonants or between oral and nasal consonants, to finer differentiations, such as the manner, place or voicing of a phonological segment. He suggested that the earliest developing syllables show the most extreme oppositions such as the closed/open contrast of plosive consonant and open vowel in a CV syllable such as /pa/ (Jakobson, 1968). He described the earliest words a child produces as only employing a few contrastive features. Thus, a vocabulary of 'mama' and 'papa' only requires the vowel/consonant and nasal/oral feature distinctions. These limited and extreme contrasts of the earliest sounds were considered to allow greater ease of articulation.

The associated concept of *markedness* relates to the complexity of sound articulation and perception of phonemes (Ingram, 1976). Unmarked phonemes such as /m/ are less complex, they have fewer features or marks (Chitoran & Cohn, 2009). An *unmarked* phoneme will have priority in order of acquisition over more *marked* phonemes such as /r/. Unmarked phonemes are considered to be universally acquired earliest and less likely to be subject to developmental errors such as deletion or substitution (Durand & Prince, 2016). As children's language develops, they add progressively more marked phonemes, such as /t/, /s/, /l/ and /j/ with new words. For example, when a new word is added to an early lexicon consisting of bilabial plosives, and that word includes a /t/, for example as in 'butter', this introduces a new *feature*, i.e. one of placement but not manner.

The markedness of phonemes is derived from their *distinctive features* (De Lacy, 2006). Features themselves are marked or unmarked. An example of an unmarked feature is the voiceless rather than voiced feature in plosives (Chitoran, Coupé, Marsico, & Pellegrino, 2009). Jakobson's concept of *stratification* (1968) of the phonological components of language has come to be referred to as markedness

(Durand & Prince, 2016). Jakobson describes how children begin with one distinctive feature differentiating phonemes, and gradually add features with the acquisition of each new word. Jakobson theorised that unmarked phonemes, those that take priority, are also more universal in inventories, according to his *laws of universal solidarity* (1968, p. 58). That is, they are more likely to be seen in the inventories of the world's languages.

Research in English has confirmed that there is a generally predictable order of acquisition of sound segments based on their features. Phonological research in English has led to an accepted English phonological inventory and sequence with some minor variation, possibly as a result of differences between study criteria (B Dodd, Holm, Hua, Crosbie, & Broomfield, 2006).

It is commonly reported that children make similar errors in their developmental approximations of target phonemes. Proponents of the Natural Phonology School refer to the rules leading to these approximations as *phonological processes*. These rules are considered to be determined by articulatory and perceptual competence, rather than through phonological concepts (Bybee, 2001; Hodson & Edwards, 1997). Processes considered to be universal are thought to be the child's response to articulatory complexity (Donegan, 1979) whereby children universally create rules to reduce the complexity (B Dodd et al., 2006; Leung & Brice, 2012). Studies of infant babbling (MacNeilage & Davis, 2000), led Locke to suggest that the child replaces more perceptually and physiologically complex sounds, the marked sounds, with default unmarked sounds (Locke & Eilers, 1985). For example, the replacement of velar sounds by coronal ones, such as /t/ for /k/ are an example of *fronting*, a common English developmental error (Ingram, 1974).

2.1 Markedness and Faithfulness Constraints

Optimality theory seeks to clarify why some marked sounds appear earlier in some languages than others (De Lacy, 2006; Polo, 2018). It postulates a system of constraints in conflict during phonological acquisition (D. A Dinnsen & Gierut, 2008). The preference for an unmarked sound in the phonology is described as a *markedness constraint* whereby the universal pressure holds sway. *Faithfulness constraints,* by contrast, favour marked sounds that are part of the child's ambient language environment (De Lacy, 2006). Optimality theory addresses the developmental sequence whereby maturing children begin to be less influenced by universal phonological rules and attend to the specific features of their ambient language. It is thought that markedness constraints prevail in younger children's phonologies but over time these are replaced by faithfulness constraints which conform to the inputs modelled by the speakers in their language group (Kehoe, 2011). Conflicting markedness and faithfulness constraints are prioritised in language-specific hierarchies (Dinnsen & Gierut, 2008), leading to specific sequences of acquisition between languages, according to the features of a sound. Cross-linguistic research has sought to examine phonological development in a range of languages to further explore current theories of phonology as well as provide evidence to support clinical practice (Hua & Dodd, 2006a, 2006c; Ingram, 2008; McLeod, Verdon, & Bowen, 2013).

2.2 Evidence from Cross-Linguistic Phonological Studies

There is some evidence of cross-linguistic parallels in the inventories and developmental sequence of phoneme acquisition (Slobin, 2006). For example the University of California, Los Angeles (UCLA) Phonological Segment Inventory Database (UPSID) has collated evidence of phonemic features and inventories from over 317 languages (Maddieson & Precoda, 1989). Although not covering all of the

world's over 7000 languages (Simons & Fennig, 2018), it does claim to have sampled each major subgroup of each language (Maddieson & Abramson, 1987). Thus far the information provided by UPSID indicates the universality of vowels and the plosive, nasal and fricative features. For example, more than 97% of languages that have been studied have nasal consonants (Crystal, 1987). The twenty most frequent consonants in the world's languages include plosives in four places: /p, b, t, d, k, g, ʔ/, fricatives in four places /f, s, ʃ, h/, a voiceless affricate /ʧ/, nasals; /m, n, ɲ, ŋ/, and approximants; /w, l, r, j/ in three places (Crystal, 1987). Locke summarises the broader findings in the search for an inventory of segmental phonological universals briefly as follows: all languages have stops but not all have fricatives, all languages have single consonants but not all have consonant clusters, every archived language has a consonant-vowel (CV) syllable structure (Locke, 2000).

A recent cross-linguistic review by McLeod and Crowe (2018) of 64 SLP studies of consonant phoneme acquisition in 31 countries and 27 languages, aims to give overall clinical guidelines for SLPs working cross-linguistically (2018). Patterns of feature acquisition showed nasal consonants amongst the earliest with plosives preceding fricatives. This further supports the developmental priority of certain features and segments over others in the world's languages.

General trends in the universal sequence of sound acquisition have also been supported by individual cross-linguistic studies (Amayreh & Dyson, 1998; Fabiano-Smith & Goldstein, 2010b; Ruiz-Felter, Cooperson, Bedore, & Peña, 2016). For example, data from feature analysis supports the precedence of stops over fricatives (Amayreh & Dyson, 1998; Kim & Stoel-Gammon, 2009, 2011).

The late acquisition of the /r/ phoneme, which is realised variously as a tap, flap, retroflex or approximant in the world's languages, is regularly confirmed as

universal. For example Ballard and Farao (2008) studied 20 bilingual Samoan children aged 4;0 -4;11 and found they had acquired most sounds in the phonetic inventory by their fifth year except /r/ and long vowels (2008). A study of 70 Xhosa children found they made more errors on the /r/ phoneme than any other (Mowrer & Burger, 1991). Similarly, a study of 240 Portuguese–speaking Brazilian children found late acquisition of the /r/ phoneme, /l/ and retroflex nasal /ɲ/ (Da Silva, Ferrante, & Van Borsel, 2012). A cross-sectional study of 24 Swahili-speaking children by Gangji, Pascoe and Smouse (2015) found the latest acquired sounds were /θ/ and /r/ which were acquired by their group aged 5; 6-5; 11. Cohorts of 36 Setswana-speaking 3;0-6;0 year-olds (Mahura & Pascoe, 2016) and 80 Kuwaiti Arabic-speaking children (Ayyad, Bernhardt, & Stemberger, 2016) were other populations with late acquisition of the /r/ phoneme.

Cross-linguistic studies nevertheless can challenge the universality of some aspects of phonological acquisition, but this is in the context of the complexities inherent in compiling comparisons of cross-linguistic studies (Hua & Dodd, 2006c; McLeod & Crowe, 2018). Differences cross-linguistically in phonologies and phonotactic structures, such as the number of permissible syllabic positions or consonant cluster size, are one source of complexity (McLeod & Crowe, 2018). Another is the variety of methods, procedures and criteria used by researchers, even within a single language (B Dodd et al., 2006). This may lead to some differences in the results from different scholars for inventories and universality.

Cross linguistic studies also challenge the universality of feature acquisition, showing exceptions and differences to the inventories and sequence of phonological acquisition according to an individual language's ranking of features. An example is the way that relatively rare marked phonemic segments such as the dental fricatives

[θ] and [ð] may occur at different stages in different languages. The dental fricatives, which are acquired late in English (Hua & Dodd, 2006c; Ingram, 2012), are acquired early in Greek. The liquid class in English, including segments such /l/, is associated with a high level of phonetic complexity (Powell, 2011) and is subject to developmental processes in English (Catano, Barlow, & Moyna, 2009, p. 452). However this is not the case in Cantonese, Spanish and Arabic (Amayreh & Dyson, 1998). The early acquisition of the marked back sounds in Arabic: the pharyngeal guttural /ħ/ (Ayyad & Bernhardt, 2009) and velar fricative /X/ (Amayreh & Dyson, 1998) also are outside universal patterns.

A study of monolingual Putonghua (Modern Standard Chinese) by Hua and Dodd (2000) gave only limited support to commonly held beliefs about phonological acquisition. Although supporting the acquisition of nasal before oral phonemes, and stops before fricatives, it showed little difference in the acquisition of front and back consonants in Putonghua (Hua & Dodd, 2000). Rather than the concept of universal templates of phonological development, it may be more accurate to speak of patterns of acquisition (Macken & Ferguson, 1981).

The phonological processes used by children also vary between languages as they respond to language-specific constraints during development. A study of Xhosa children by Mowrer and Burger (1991), found the children had a similar sequence in mastery of consonant types in comparison to English speakers. However, unlike the English studies, there were very few plosive or fricative developmental errors. Instead, the clicks in their inventory were more subject to error patterns. The processes that appear in languages are related to the features of that language. Deaffrication occurs early in the acquisition of phonologies with affricates and

deaspiration and de-dentalisation in multilingual children acquiring dentalised consonants in Punjabi (Hua & Dodd, 2006a, p. 439).

Gliding of /r/ is often identified as a process (Grunwell, 1987) based on the English-speaking developmental pattern, however this is not universal. For example in Italian the trilled /r/ is commonly replaced by /l/ rather than a glide (Miccio & Scarpino, 2009). Cross-linguistic surveys of error patterns found that processes considered atypical in English were seen in the development of typically developing Cantonese-English bilinguals and Portuguese speakers (Da Silva et al., 2012; Holm & Dodd, 1999). Swahili speakers' frequent lateralisations (Gangji et al., 2015) and Samoan children's atypical error processes (Ballard & Farao, 2008) also reinforce that the processes involved in phonological acquisition vary cross-linguistically.

Cross-linguistic researchers have hypothesised about the mechanisms that may be driving these variations in acquisition of different groups of phonemes between languages (Mowrer & Burger, 1991). These include the frequency of the sound in the ambient language and also the *functional load* or frequency and number of functions of a sound in the lexicon (Ingram, 2008). Functional load predicted 55% of the variation in consonant emergence in an English study (Stokes & Surendran, 2005, p. 587) as well as cross-linguistic studies (Ballard & Farao, 2008; Kehoe, 2011; Liu-Shea, 2011). Frequency is important in languages with smaller phonologies (Stokes & Surendran, 2005). Variability between languages in the stage and rate of segmental acquisition has also been linked to their frequency in the language (Polo, 2018; Van Severen et al., 2013). A specific example is the early acquisition of complex, marked sounds, such as the Arabic /ħ/ (Ayyad & Bernhardt, 2009; Chitoran et al., 2009). The relatively early acquisition by Arabic speakers of the marked velar fricative /X/ also

may be linked to the fact that its functional load is high, as it is contrastive with many classes of consonants in a variety of places (Amayreh & Dyson, 1998).

Zhu Hua and Dodd identified *saliency* as an important mechanism of phonological priority in acquisition (Hua & Dodd, 2006b). This was clear in their study of Putonghua speakers (Hua & Dodd, 2000), where tonal values are highly salient, largely because of their compulsory nature. This concept has limitations of application both at the phonological rather than syllabic level and for languages such as TP, in the preliminary stages of their research, where the compulsory features may not be as clear.

Multilingual phonological acquisition exposes children to, and requires them to acquire, the phonemes of more than one language. This introduces a greater level of complexity which leads to important questions of how the child responds to their phonological environment. The enormous array of multiple language use phenomena in the world also generates an entirely new subset of terminology which we will not explore here. In PNG multilingualism is more frequent than bilingualism, and throughout this document we will adopt the convention of referring to both *bilingualism* and *multilingualism* using the term multilingualism.

2.3 Multilingual Phonological Acquisition

Multilingualism is the rule rather than the exception in the world (Bi, 2017; Velupillai, 2015). Studying the characteristics of multilingual speakers can contribute important insights to linguistic and cognitive theory and research (McSwan, 2017; Velupillai, 2015). Such studies can, for example, test the universals proposed in monolingual studies, highlighting language specific variations (Bernhardt et al., 2015; Paradis & Genesee, 1996) and potentially leading to a reassessment of models of development (Hua & Dodd, 2006a). This section addresses some of the

complexities of multilingual phonological acquisition: how multiple phonologies impact the rate and nature of acquisition, whether one or multiple phonologies are formed (Fabiano-Smith & Goldstein, 2010b; Genesee, 1989), what code-mixing indicates, what it may achieve and how universal acquisition patterns and error processes function in multilingualism. At two levels; the cognitive-linguistic level, and the level of the sociolinguistic setting, mechanisms interact to produce the complexity of multilingual phonologies. Multilingual studies inform phonological development theory as they show how universal tendencies and personal autonomy interact during phonological acquisition and the clinical implications of acquiring normative data for such populations.

Comparative studies of multilinguals also have some inherent complexities. A significant one is the difficulty in finding a cohort of participants matched in age and stage for both languages (Fabiano-Smith & Goldstein, 2010b).

2.3.1 Mechanisms of multilingual phonological acquisition. Levelt (1989) proposes a model of phonological encoding entailing two encoding steps in sourcing components from a mental lexicon. First, choosing a lexical item, or *lemma* from the mental lexicon, and second, matching it to a phonetic or articulatory program, the *lexeme* for the phonological encoding (Levelt, 1992, p. 4). When Levelt's model is applied to bilingual and multilingual speakers it is postulated that language choice is part of the message and is made with the selection of the lemma (Broersma & De Bot, 2006), which in turn dictates the phonological encoding. De Bot's multilingual processing model (2004), based on Levelt, conceptualises subsets of storage for the different language lexicons of multilingual speakers. This model proposes that word selection is non-selective, that is words, or lemmas, can be accessed from any of a multilingual speaker's languages. However, a language's level of activation does

depend on the speaker's relative proficiency related to frequency of use. It may be that when a child's two languages have shared phonological features and segments, proficiency in one language can trigger phonological elements in the other (De Bot, 2004). Thus, when a child is exposed to multiple languages one must consider the mechanisms at work in the selection of lemmas and their intrinsic lexemes.

Comparative studies of first and second language (L1and L2) acquisition reveal that each language is subject to different mechanisms (Velupillai, 2015). For a child acquiring multiple phonologies, both language learning and language differentiation occur. The developmental tasks for a child of selecting a phonetic inventory, determining contrasts and learning distribution rules, all increase with each language added (Yavas & Goldstein, 2006). In addition, the age of language exposure, the language practices of different sociolinguistic groups, the linguistic similarities of the languages combined and the relative weight each phonology gives to particular phonemes, may have an effect.

2.3.1.1 Simultaneous and sequential multilingualism. Complexity arises in multilingual acquisition from variation in the age and stage when children are exposed to their second and subsequent languages and the opportunities for language use (Ruiz-Felter et al., 2016). Some children may be *simultaneous multilinguals*, others may acquire subsequent languages later, so they are *sequential bilinguals*. Studies of English as a second language in English-speaking countries (Gildersleeve-Neumann, Kester, Davis, & Pena, 2008) are abundant. The linguistic context of the *majority world*, formerly referred to as the *third world* (Akpovo & Nganga, 2018), is different to the *minority world*. In the majority world, simultaneous multilingual acquisition presents a more complex picture than second language acquisition in the more monolingual minority world.

Studies reveal that there is variation both in timing and amount of various language inputs for children acquiring their phonologies (Fabiano-Smith & Barlow, 2010; Hua & Dodd, 2006b; Lim, Wells, & Howard, 2015). Phonological variables plus non-linguistic variables such as social pressures, age and degree of language output practice may all impact phonological acquisition in the multilingual child (Gut, Fuchs, & Wunder, 2015).

A study of phonological acquisition in Spanish/ English bilingual children found that variability in the age of exposure to each language leads to variability in phonological performance as measured by PCC (Fabiano-Smith & Hoffman, 2018). Ruiz-Felter, Cooperson, Bedore and Peña (2016) found the sequence of phoneme acquisition to be a function of shifting language dominance during Spanish/English bilinguals' phonological acquisition, caused by the level of input and output of each language. Similarly, in the English /Cantonese study by Hua and Dodd (2006c), children with later exposure to their second language (L2) were observed to have acquired better first language (L1) phonological accuracy than L2 phonology.

Languages acquired simultaneously will be subject to phonetic transfer (Fabiano-Smith & Barlow, 2010), but this will occur differently for each child (Gut et al., 2015). Different mixes of variables at each sociolinguistic level is likely to result in a corresponding complexity in child phonological development, even within the same populations and age-groups. They will include variants from each language that are either marked or unmarked and which a child must trial, match and either incorporate, or discard for each phonology (Kopečková, 2015). We have already seen that cross-linguistic studies reveal language-specific exceptions to the universal preference for unmarked phonemes. In multilingual acquisition there may be

complex interference from one language's subset of phonological encoding to another.

2.3.1.2 Variation and interference. When children are exposed to multiple phonologies, they must balance faithfulness and markedness constraints and therefore variation or interference is likely in their early phoneme use. Siegel (1999) proposes that, what he terms *language distance,* which is a level of typological similarity, may lead to interference from the phonological content of one language to another. Yang and Hua propose that phonological interference in bilingual language acquisition is evidenced by specific behaviours. These include the use of features specific to one language in another language which the child is acquiring, or by applying the phonotactics of shared phonemes incorrectly across languages (Yang & Hua, 2010). Children acquiring second and third phonologies bring with them knowledge of articulatory rules from previously acquired phonologies (Kopečková, 2015).

Developmental studies can clarify at which point this previous learning, rather than interfering, begins to assist individual children's phonological acquisition. By contrast, some researchers have proposed a multilingual advantage during development when phonological overlap may act to accelerate acquisition (Lim 2015).

2.3.2 Rate of acquisition in multilinguals. Research thus far has not produced consensus as to whether the rate of acquisition of phonological segments is comparable between multilingual children and their monolingual peers. Whilst a study of Putonghua/Cantonese and English/Indian language multilinguals (Hua & Dodd, 2006c) found slower rates of phonological acquisition than in monolinguals, other studies contradict this. By contrast, some researchers propose that bilingual

children can be compared to their monolingual peers when referred for assessment of speech disorder.

Research into the phonological development of Spanish/English bilingual children, for example, found the rate and accuracy of their phonological acquisition in each language equal to their monolingual peers (Goldstein, 2001; Goldstein & Kohnert, 2005). Fabiano-Smith and Barlow examined the phonetic inventories in single words of 24 three to 4-year-old children. Comparing groups of bilingual Spanish-English, monolingual English and monolingual Spanish speakers, they found that bilingual children acquire the complexities of two phonetic inventories in the same duration that monolinguals acquire their single inventory. It should be noted that the authors were careful to measure and match the language exposure in each language (2010).

In a study of multilingual phonological acquisition in Malaysian children, Lim, Wells and Howard found that the multilingual children's phonological milestones were comparable to their monolingual and bilingual peers (2015). Both Lim et al and Fabiano–Smith and Barlow (2010) hypothesised that the load of acquiring two phonologies was counteracted by supportive interaction between multiple languages, leading to equal performance in both languages.

There have been strong claims for a multilingual advantage in language acquisition which some studies have applied to phonological acquisition. A study of 19 young multilingual German speakers acquiring Spanish were shown to be advantaged in the acquisition of the marked /r/ and /ɾ/ segments when they were active bilinguals in languages such as Croatian and Russian which contained these segments (Kopečková, 2016). A study of bilingual children acquiring Putonghua were advantaged in their acquisition of affricates (Hua & Dodd, 2000), which Hua

and Dodd suggest may have been the result of those segments being shared components of the children's Cantonese inventories (Hua & Dodd, 2006c). Research in this area is confounded by the use of different measures and the degree to which variables such as language inputs are factored into the measurement (Fabiano-Smith & Barlow, 2010).

Reviews of multilingual studies have attempted to summarise what is universal and what can be language-specific in phonological acquisition. However, these summaries are not conclusive. A review of the phonologies of 15 languages by Hua and Dodd (Hua & Dodd, 2006a) found, in contrast to McLeod's cross-linguistic review (McLeod & Crowe, 2018), that phonetic inventories were generally acquired by around three years. It confirmed that the acquisition of vowels was earlier than consonants, that nasal and plosive consonants were acquired early, liquids later and unaspirated consonants had precedence over aspirated (2006a). The inventories of the languages surveyed all included the consonants /p/, /n/, /f/, /s/ with most also containing /h/, /t, k/ and the vowels /i, u, a/ (Hua & Dodd, 2006a). Overall however, Hua and Dodd challenged Jakobson's laws of universal solidarity linking the frequency of phonemes in inventories universally with the order of acquisition of phonemes (2000).

The model proposed by De Bot for word-based multilingual phonological acquisition (2004) leads us to conclude that children acquiring multiple languages must deal with multiple lemmas and lexemes. These can cause interference from one phonology to another, but may in time accelerate rates of phonological acquisition. Additional sociolinguistic factors such as the age of exposure to subsequent languages, must be factored into the equation, and will lead to variation. Multilingual

children have a complex task of ranking and re-ranking feature hierarchies during acquisition. However, work is this area is just beginning.

2.4 Contact Languages and Phonological Acquisition

The target population of this study are speakers of the creolising pidgin, Tok Pisin (TP). The nature of TP will be discussed in detail in chapter three. This section outlines the nature of *pidgin* and *creole* languages and how they may further complicate the picture of multilingual phonological acquisition.

2.4.1 Pidgin and creole languages. *Contact languages* occur when there is a sustained need for speakers of mutually incomprehensible language groups to communicate in more than a trivial fashion (Operstein, 2015; Reinecke, 1938). The most enduring of these are pidgin languages which are used when multiple groups are in ongoing contact (Siegel, 2008; Wardhaugh, 2010). Usually one of the languages has a dominant position (Wurm, 1984). This has often been in a situation of forced labour, such as the slaves in Jamaica and Malacca (Reinecke, 1938) or the plantations of the Pacific region (Wurm & Mühlhäusler, 1985). Pidgins should be distinguished from other ad hoc contact language varieties such as jargon or koine languages, which are a blend of two or more languages (Siegel, 1985; Velupillai, 2015). Pidgins are simple languages, but have their own set of rules (G. Smith, 2002).

2.4.1.1 Linguistic structure and functions of pidgins. In the contact situation where the Pidgin is formed, the dominant prestige language usually supplies most of the vocabulary, that is, it is the main *lexifier* language (Mufwene, 2015). The minor languages nevertheless have a critical role in the syntax, phonology and suprasegmentals of the pidgin (Wardhaugh, 2010). These are referred to as *substrate* languages and are generally the native vernaculars of the contact language speakers.

In TP this resulted in grammar, phonology and phonotactics heavily influenced by substrate language phyla and nuanced local usage reflecting the local substrate, primarily in accent and local vocabulary (Bee, 1972; Franklin & Thomas, 2006; Goulden, 1989).

As the sole function of a pidgin language is to exchange information, it is a simplified form (G. Smith, 2002). Pidgin languages are relatively easy to learn because in comparison to natural languages; they have smaller vocabularies, fewer grammatical categories and are less grammatically complex (Sankoff & Laberge, 1973). Morphologically, pidgin languages lack inflections, have free rather than bound grammatical morphemes, and agreement between tense and number is not expected. There are, for example, generally no tense markers for verbs or qualifying prefixes for nouns in most pidgin languages (Velupillai, 2015).

However, unlike jargon or koine languages, a pidgin is not a variable blend of half learnt languages but has the structure of a language and must be learnt. They become a second or subsequent language to act as a *lingua franca* between language groups when needed, predominantly in particular domains for particular functions (Velupillai, 2015). An example with Tok Pisin is its use in trading settings and local government council meetings between language groups (Nidue, 1990)

Pidgin phonology typically has fewer phonemes than the languages they are derived from (Velupillai, 2015). Phonemic inventories generally substitute marked sounds in the lexifier language with unmarked sounds (Kinney, 2005). Each phoneme however may have a number of allophonic realisations (Fromkin, 2009). Typically pidgins lack contrastive tone (Velupillai, 2015, p. 30).Vowels are usually limited to five of the cardinal vowels and lack contrastive length. Syllable structure tends to follow a Consonant-Vowel-Consonant-Vowel (CVCV) pattern (Kinney,

2005), and the words of lexifier languages may undergo changes to satisfy this structural demand. For example, English /skreip/ 'scrape' can become /sıkrap/ in Tok Pisin (Mihalic, 1989, p. 173).

Pidgin languages move through various stages as they stabilise. The initial language mixing is followed by a levelling out of differences (Siegel, 1997b), and a simplification which includes removal of marked features and reduction in redundancy (Operstein, 2015). When a pidgin language is regularly used in a large number of settings, it becomes both more stable and more complex, so is often referred to by creolists as an extended or expanded pidgin language (Velupillai, 2015). Some pidgin languages last only a brief time, but if the language continues to serve its purpose, even expanding into other arenas, it begins to change. Creole languages are the next step, emerging once pidgin forms stabilise and it becomes the native language of speakers (Sankoff & Laberge, 1973).

2.4.1.2 Creolisation. First language, or native speakers, of a pidgin language will change and develop the language. This process is called *creolisation* and the language is known as a creole language (Siegel, 2013). Its grammar may be expanded with resources from the substrate language (Siegel, 2003) as well the lexifier language, as a result of the creolisation process. The creole grows in its structure and capacity such that creoles are regarded by linguists as full languages able to fulfil all the functions its speakers require (Velupillai, 2015).

There are various stages in pidgin-creole development, and the progression can vary. Creolisation progression results from the combination of several processes such as transfer, reduction and mixing which combine in various ways, depending on the unique sociolinguistic setting of a given pidgin (Mühlhäusler, Dutton, & Romaine, 2003; Siegel, 2013).

2.4.2 Phonological acquisition in multilingual creole populations.

Developmental phonological research in populations that include a contact language must not only consider the role of universal patterns on children's development, but also the impact of acquiring multiple language types and the rapid change inherent in creolising languages. There is a complexity in creole language acquisition caused by universal forces directing child creole development and interacting with the changing adult input model (Yip, 2007).

Sociolinguistic factors impacting language use are part of the equation impacting creole language development and contribute to the challenge of its description. These include interference from substrates and lexifiers, loan word phonology, family inputs and a range of language domain use (Haspelmath & Tadmor, 2009; Matras, 2009). *Areal influence*, whereby languages in intimate and sustained contact over time give rise to borrowings that influence creole language development (N. Smith, 2007) leads to regional dialects. An example is the TP pronoun forms originally borrowed from PNG substrate languages (Matras, 2009). The idiosyncratic innovations which become established forms (Bickerton, 1984) and the simplification and levelling due to creolisation (Siegel, 1997b), add further complexity.

The result is a high level of variation. Any neat definition of a language is challenged by the fluidity of multilingual settings, and the extreme variability of a creolising language undergoing significant change. Thus it can only be defined specifically in relation to the way its speakers function in their given context (García, 2009). Creole-speaking children on Reunion island, for example, may belong to one of five language profiles. These language profiles, or *interlects*, consist of a number

of intermediate mixed forms with differing levels of contribution from French and Reunion Creole (Lebon-Eyquem, 2015).

2.4.2.1 Variation and interference in creole language learning. The interference between languages in multilingual speakers, is intensified in creole languages by a high level of *code-mixing*. Code-mixing is a feature of multilingual language acquisition that may lead to phonological impact through loan word adoption. Code-mixing is usually defined as: 'language mixing within the phrase or utterance' (Matras, 2009, p. 101). Code-mixing occurs where there are two languages used either within a clause, or in adjacent clauses, phrases or utterances (Broersma & De Bot, 2006).

Loan word adoption can be a longer term result of language mixing (Poplack & Dion, 2012). Where multiple language-use is widespread, adult speakers using *loanwords* attempt to replicate the phonology of the donor language, especially if it is considered prestigious, and there is a spread within the adult models. An example is the use of English count nouns in trade settings in PNG. These words bring new phonemes such as /θ/ in /θri/. Consequently additional phonemes, as they occur in particular loanwords, are imparted to children of the recipient language (Matras, 2009). Thus, new phonemes modelled in loanwords may lead to enduring changes (N. Smith, 2007).

However, inevitably adult models may show various levels of approximation of phonological targets (Matras, 2009). Code-mixing can also happen temporarily, for stylistic or other sociolinguistic reasons. Such temporary borrowings are termed *nonce borrowings* (Poplack, 2012; Poplack & Dion, 2012) and do not lead to permanent changes (Matras, 2009). Rather the words are 'nativized' (N. Smith, 2007, p. 79), adopting the recipient phonology.

Children may learn phonological changes from adult models, or the creolisation process may lead to phonological change. Quite young children can anticipate phonological change and implement it even before their parents. Australian Warlpiri children, for example, contributed to differentiation between the Warlpiri and Light Warlpiri languages by exhibiting a change in the phonology earlier and more often than their parents (O'Shannessy, 2005, 2015). De Bot's Multilingual Processing Model (2004) conceptualises subsets for different languages at each level of language storage. When languages are similar, language elements, including phonological units, are shared between subsets. Shared cognates increase the likelihood of codeswitching behaviour being triggered (Broersma & De Bot, 2006). For the child learning two or more languages, borrowed words lead to conflicts in phonological rules that must be resolved as the word is absorbed into the lexicon.

2.4.2.2 Rapid speech in creolisation. Researchers observing children who speak a creole as their native language note that they will speak more rapidly than adult L2 users (Bickerton, 1984; Smith, 2002). This results in elision of some segments and syllables. This *morphophonemic condensation* can in turn lead to phonological, phonotactic and morphological changes in the language (Mühlhäusler et al., 2003; Romaine, 1992).

2.4.2.3 Ongoing lexifier impact in creolisation. The creole language is more likely to show interference from the lexifier than the substrate, due to the linguistic distance between substrate languages and lexifier languages being greater than that between the lexifier and the contact (pidgin or creole) language (Siegel, 1999). Thus English-lexified creole languages which are still in contact with the lexifier, because it is the Language of Wider Communication (LWC), may continue to borrow words from the lexifier, and with them, more phonological detail. Sometimes this leads to a

continuum between the lexifier and creole language, and the creole may even be reabsorbed back into the lexifier language. However, important sociolinguistic functions of the creoles can lead to the perpetuation of its autonomy (Siegel, 1997b).

2.5 Gender and Phonological acquisition

The relative rates of phonological acquisition according to gender have varied support in the literature. There is some data in phonological development milestones supporting the earlier acquisition of phonemes by girls than boys (Kilminster & Laird, 1978; Quast, Hesse, Hain, Wermke, & Wermke, 2016; Sharif, 2015; Templin, 1963). However, in contrast, several cross-linguistic studies of phonological development have found no gender differences in phonological development (Ballard & Farao, 2008; Coloma, Pavez, Maggiolo, & Penaloza, 2010). In general, the research support for gender difference is tentative with a need for more data on gender patterns in phonological development in a variety of linguistic contexts.

2.6 Methodological Considerations in Measurement of Phonological Development

Each phonological research project will make methodological choices that require a balance between the theoretical demands of the language setting, and the practicalities of each individual project. There are several variables to consider when deciding the methods required for a phonological study in a multilingual situation. Projects that seek an understanding of the universal features of language development, must, as far as is practicable, adhere to internationally comparable criteria. There is a need to establish which concepts require comparison (Haspelmath, 2010) and definition of the criteria used to measure the comparisons (Hua & Dodd, 2006b). The definitions of key terms, criteria and sampling design of the study (Mowrer & Burger, 1991) increases the value of cross-linguistic comparisons. This includes definition of the criteria determining what constitutes acquisition of

phonemes by each individual participant and each designated age band. Procedural approaches such as methods of eliciting samples, the stimuli used, and manner of presentation, all require definition, as they vary with different cultural demands (Hua & Dodd, 2006b).

More generally, within the multilinguistic context, it is important to clearly define the language being studied and its patterns of use. This must include reference to the speakers and their social context (Garcia, 2011). In the context of this study (i.e. PNG), one challenge is the fact that a creolising language, which is also subject to language mixing, is being used. Language mixing alters what is being measured and means that typical patterns are difficult to identify (Gangji et al., 2015). It seems likely that the wide-ranging variation in language input patterns in PNG will lead to variation in developmental outputs. The challenge is to identify the specific variables of phonological development that are relevant in every setting, in order to measure them accurately.

2.6.1 Design. Clinical linguistic studies are motivated by the need to identify the typical range of ages within which a clinician can expect phonotactic structures and individual segments to be mastered and speech to be intelligible. Cross-sectional studies, especially large ones, contribute to this goal (Lim et al., 2015). First language research emerging out of linguistic schools favours longitudinal studies (Forshaw et al., 2015) and developmental studies in PNG have been typological longitudinal studies involving small groups of children (Rumsey, 2014, 2017). Although clinicians may draw on the theoretical insights typological studies reveal, they are also aware of the need for data that is generally applicable in a clinical setting. A cross-sectional study of a larger number of participants allows a time-effective overview of development seen in a representative group of children at one

point of time. This requires a clear delineation of variables, including which language group or multilingual group should take research priority and which components of phonology should be measured.

2.6.1.1 Sampling techniques in cultural context. Phonological samples may be obtained from conversational speech or from single word picture naming tasks.

Whilst conversational elicitation has the advantage of using children's current vocabulary, showing syntax effects and providing data on the frequency of occurrence of phoneme targets (Grunwell, 1987; Kim, Kim, & Stoel-Gammon, 2017) there are associated challenges. A single word elicitation task provides a glossable, comparable set of target words. These can be carefully selected to represent a comprehensive range of phonemic targets in a range of syllabic contexts (Masterson, Bernhardt, & Hofheinz, 2005). Spontaneous elicitations of words are ideal, but children's imitation of words not elicited spontaneously can also be used (Ingram, 1995; Johnson, Weston, & Bain, 2004). Recent research by Mcleod and Masso (2019) supports the effectiveness and efficiency of imitated productions. Some studies include word repetition tasks for targets not readily elicited by pictorial stimuli (Mahura & Pascoe, 2016).

2.6.1.2 Challenges in unexplored research domains. New settings for research will require inclusions not always necessary in established areas. The provision of new materials, measurement tools and appropriate cultural adaptations will be a normal part of the research process.

The cultural preferences of the children in a new setting must be considered in selecting sampling techniques and balanced against practical sampling considerations. Structured tasks allow better control of the sample than free play and conversation. Structured tasks are also a more time-effective method of covering the

targeted data. In situations where individual tasks are not a usual part of cultural behaviour, familiarisation to such structured approaches may give children the confidence to participate without penalty.

In cross-linguistic phonological studies the usual resources for selecting appropriate test vocabulary are not as well developed as in more frequently studied language groups. Therefore, the structure of research in such settings will include an element of identifying and field-testing appropriate word targets for that population. Word selection needs to be a careful process that considers factors such as word-length and phonotactic probability (Edwards & Beckman, 2008). Control for phonetic content and word-length must accommodate the smaller vocabularies of young children (Edwards & Beckman, 2008).

2.6.2 Native speaker expertise. In multilingual settings it is important to draw on native speaker expertise. This is of significant value culturally but also in terms of awareness of the multilingual equation in the research setting.

Researchers have used trained native speakers with phonetic expertise (Santini, 1995), but in some majority world settings, such as PNG, this may not be an option. The native speaker's perception of a child's utterance will most closely match the phonological perception of most speakers in the child's speech community (Edwards & Beckman, 2008; Munson, Edwards, Schellinger, Beckman, & Meyer, 2010). It has been suggested that this approach may, in the early stages, be more valuable than acoustic analysis, when the importance of contrastive function exceeds that of a fine-grained phonetic analysis that definitively outlines allophonic variation (Ball, 2008; Ball & Rahilly, 2002). Thus, native speakers' input during transcription is commonly used (Romaine, 1992; Rumsey, 2017). It greatly enhances the reliability of data and contributes to appropriate language standardisation.

2.6.3 Foci of clinical research. Study of both the universal and language-specific properties (Hua & Dodd, 2000, p. 5) of cross-linguistic phonological acquisition are valuable foci for research as both provide significant insights into the phonology studied (Ingram, 2008). Phonological studies address universal patterns through their study of phonetic and phonological inventories, patterns of developmental phonological processes (Kehoe, 2011; Stoel-Gammon, 1985, 2010), the roles of prosody, phonotactics and grammatical interactions (Ingram, 2008).

Consonant acquisition is one of the most frequent measures of typical phonological acquisition (Edwards & Beckman, 2008). There are several reasons to prioritise study of consonant development: Consonant errors are more likely than vowel errors (Grunwell, 1987) and vowels can be more difficult to transcribe, requiring acoustic analysis in addition to input from native speaker perception (Edwards & Beckman, 2008). In addition, older children, who are still acquiring consonants, may be more accessible and more able to participate in research.

Phonological analysis generally employs both relational and independent analyses for clinical purposes (Baker, 2004) and in research (Mahura & Pascoe, 2016). Independent measures describe the individual child's performance and relational measures compare their performance to the adult standard for segments and phonotactic structures. Independent measures include phonetic, phonological and phonotactic inventories. With smaller numbers in clinical settings, independent analyses of each child's phonological contrasts are possible. A phonemic evaluation, producing phonological inventories, as an independent measure, involves a different level of analysis to phonetic inventories (Byun & Rose, 2016). Detailed analysis of each utterance establishes which phones are used contrastively to carry meaning in the same way as adult target segments and are thus functioning as phonemes within

the child's system (Grunwell, 1987). Although this can be established with individuals or small groups of children, such a method has limited feasibility in large cross-sectional studies without access to one of the available software packages (Byun & Rose, 2016; Oller & Delgado, 2000) for analysis.

Relational analyses, such as phonological and developmental process inventories, compare phonological performance to the adult model and provide useful information in a time effective manner. Relational analyses may also employ a measure such as *Percentage Consonants Correct* (PCC) (Shriberg & Kwiatkowski, 1982) to allow descriptive and inferential statistical analyses.

2.6.3.1 Criteria for independent analyses. Until recently there has been little consensus about methods for collecting, and criteria for calculating, phonetic inventories in multilingual group cross-sectional studies (Hua & Dodd, 2006b). Definitions for inclusion of phones within phonetic inventories range from recording every sound a child uses at least once (Fabiano-Smith & Barlow, 2010; Mahura & Pascoe, 2016; Stoel-Gammon, 1989), to a frequency criterion. Many researchers require the sound to occur more than once to be included in a child's phonetic inventory (Catano et al., 2009; Fabiano-Smith & Barlow, 2010; Gildersleeve-Neumann et al., 2008; Robb & Bleile, 1994; Stoel-Gammon, 1985; Topbas, 1997). Researchers have also often followed Stoel-Gammon's requirement that a sound also appeared in more than one syllabic position in a word (1985).

Criteria for inclusion in an age-group phonetic inventory can range between 50% to 90% of the age-group (Hua & Dodd, 2006b) but a range between 75% and 90% was most frequently used by contributors to Hua and Dodd's cross-linguistic multilingual review of the phonological literature (Hua & Dodd, 2006b). In this study, because of the importance of internationally comparable criteria being used in

multilingual studies (Hua & Dodd, 2006b), we have used the *more than once* criterion for individual children's use of a phone, and the 75% group criterion. However, a limitation of the more than once criterion is that it requires multiple opportunities for each phone in each syllabic position, which was not always possible with our Picture Naming Task. For this reason our phonological inventories utilised a metric which accommodated variation in opportunities.

2.6.3.2 Criteria for relational analyses. Relational criteria apply to the measures of how well children's speech matches the adult phonological model. Relational analyses of phonological inventories and developmental phonological processes have also been defined in various ways in the literature (Dodd, Holm, Hua, & Crosbie, 2003). The proportion of phoneme uses matching the adult form and the number of syllabic places in which an individual uses a sound are just some of the variables defining an individual's acquisition of a phoneme. The frequency of each child's correct matches to the adult model must show it to be an established pattern. This will depend on the opportunities available and the criteria must reflect a significant number of successful matches to the adult model. A range of criteria have been used from 50% (Goad & Ingram, 1987), on to 67.7% (Hua & Dodd, 2000) and up to 100% (Hua & Dodd, 2006b). This study is explorative, so the more inclusive criterion of 67% was selected.

Phonological acquisition is gradual with sounds acquired by children at an early age not always present at a later age (B Dodd, Holm, Hua, & Crosbie, 2003). Therefore when studying the phonological acquisition of a population, there is merit in expressing age of acquisition as a significant percentage of children in an age band who have acquired that particular consonant (Dodd et al., 2003; Hua & Dodd, 2006a). There are also various definitions of acquisition by an age group according to

the percentage of age group members who have acquired a sound. In English studies, where the typical rate of delayed speech is known, a 90% criterion is often used (Hua & Dodd, 2006b). In 64 studies of consonant acquisition, examined by McLeod and Crowe (2018), criteria varied between 75% and 100%, with 75% and 90% being the two most frequent criteria used (2018). We will observe both the 75% and 95% criteria.

We decided to observe both criteria because of the preliminary nature of this study. In languages such as English, with a depth of research, the choice of a criterion for inclusion of a sound in an age group's inventory has been, of necessity, a long term, gradual process and this criterion still varies in research between 75% and 100%. Hua and Dodd comment that "the choice of 90% has a clinical basis in the sense that it takes account of the upper range of children who may have speech difficulties" (Hua & Dodd, 2006b, p. 17). Thus the 90% criterion is based on known referral rates for SSD in the English-speaking world (B Dodd et al., 2003; Hua & Dodd, 2006b). There is not yet data available on TP SSD referral rates. Also, it is a language where there are variations, both over time and geographical location in phonological forms, which must also be considered. Additional slightly less stringent criteria for inclusion of a phoneme in an inventory, and a phonological process, may be useful at this point in the history of TP clinical research, in order to reflect the language specific nature of the variation taking place.

Many phonological studies make a distinction between phoneme acquisition and phoneme mastery because of the variability evident in children's mastery of their speech articulation (Sander, 1972). Three levels of acquisition in an age group of a population are widely used (Amayreh & Dyson, 1998; Da Silva et al., 2012; Hua & Dodd, 2000; Kim & Stoel-Gammon, 2011). The three levels, which are adapted from

Sander (1972) and have been used in cross-linguistic studies are: *customary production*, which is the appearance of the phoneme in 50% or more children in an age group, *phonological acquisition*, which occurs when 75% or more of the children use the phoneme, and *phonological mastery* by an age group which is seen when 90% or more of the children in an age group use the phoneme (Amayreh & Dyson, 1998; Kim & Stoel-Gammon, 2011). The upper two levels are widely measured in cross-linguistic research (Baker, Williams, McLeod, & McCauley, 2018). Reporting of inventories at both the 75% acquisition criterion and 90% mastery criterion was noted in seven of the studies reviewed by McLeod and Crowe and a further seven had two other criteria (2018).

It can also be helpful to display a range of ages for segment acquisition (Crystal, 1987, p. 240). In a research setting seeking early developmental data, presentations which convey a range of data between the mean customary age and the upper limits of sound mastery will overcome the risks of misinterpretation when representing essential developmental information (Sander, 1972). The range between an age group's customary acquisition and mastery gives valuable data about the variability patterns of typical acquisition (Sander, 1972).

Although originally devised by Shriberg (Shriberg, Austin, Lewis, McSweeney, & Wilson, 1997) for assessment of children with Speech Sound Disorder (SSD), the concept of *Early, Middle, Late* (EML) categories for respective languages has also been utilised in cross linguistic studies such as that for Arabic by Amayreh and Dyson (1998) and Spanish-English bilinguals (Fabiano-Smith, 2007; Fabiano-Smith & Goldstein, 2010a). The lack of detail in mean acquisition scores has been partly remedied by measuring which sounds of each phonology fall into particular stages (Ruiz-Felter et al., 2016). Early sounds are defined as those produced with 75% or

greater accuracy by 3 to 6-year-old children. Middle sounds were those produced with 25–75% accuracy and Late sounds are produced with less than 25% accuracy by the same children (Fabiano-Smith & Goldstein, 2010a; Shriberg, 1993). In English the Early sounds are: /m, p, b, n, d, j, w, h/, Middle sounds are: /t ŋ k g f v ʧ ʤ/, and Late sounds are /ʃ ð s z l r/ (Fabiano-Smith & Goldstein, 2010a).

EML may also accommodate functional load issues such as the higher frequency of early acquired sounds contributing disproportionately to a simple mean (Ingram, 1988). These developments indicate that a measure of the mean consonants correct is complemented by descriptive statistical measures indicating which sounds will appear at which ages and stages. The EML categories used in this thesis will be derived from the phonological analyses which are sourced from the original data before PCC analyses. They are designed to accommodate differences in opportunity to overcome the limitations of an average. Phonemes will be defined as (see section 5.9.2.) 100% correct in two or fewer opportunities and at least 67% correct in three or more opportunities (Hua & Dodd, 2000; Mahura & Pascoe, 2016).

Analysis of developmental phonological processes which cause departure from the adult segmental targets are also measured. There is a lack of consensus between scholars defining process categories (Dodd et al., 2003; Grunwell, 1987; Miccio, 2002). Both the definition of a criterion for counting a process present in a child's speech and a criterion for it being age-appropriate also show variation in the literature.

In reference to the presence of a process in an individual participant's speech, earlier studies have been criticised for identifying a process if it occurred once (Dodd et al., 2003). Subsequent studies have been more stringent in their criteria for identifying processes. Some criteria involve a percentage, which assumes prior

knowledge of where a process is possible or likely, which is the fruit of extensive research (Grunwell, 1977). The consensus is generally that the criterion chosen must reflect that this is a process, so that one occurrence only will not reflect a pattern, and multiple occurrences are necessary (B Dodd et al., 2003; Maphalala, Pascoe, & Smouse, 2014; Westby, 2012).

Phonological processes are a valuable tool for describing the progressive patterns of approximations in children's speech to the language targets of a group of speakers. This then allows comparison with the same process in other languages. In a cross-linguistic setting there may be processes as yet unobserved, so there is also a need to let the process analysis reflect the differences in patterns of children's approximations to the adult model. The process categories assumed from extant research into English and Indo-European languages, may not completely reflect processes cross–linguistically. The researcher in a new language must be ready for differences in occurrence and importance of processes in their particular linguistic setting (Hua & Dodd, 2006a). For this reason, this study will commence process analysis with an audit of processes, and, as well as utilising the internationally comparative criteria, less frequent instances than five times in individual children will also be monitored for discussion. Although some language specific processes may not be strong enough features in individual participants' data to satisfy the international criterion of five times, their appearance across the age bands more than once in 10% of the age bands, could be interpreted as showing an overall language specific element of phonological learning. That is, processes which occur relatively infrequently by international criteria in an individual child's speech, if they occur in enough children, may reflect the searching and sorting that multilingual children must undertake in their typical language learning process. For our reporting, for

individual children, an instance of a process must appear five times. To be considered part of the typical development in an age group, it had to be seen in 10% of the age group. However, we will monitor processes that appear more than once in 10% of an age group, as these may show the early influence on this group of the other languages the children are learning.

Relational analyses typically include a severity measure which involves the researcher calculating matches to the adult model as measured by PCC (Shriberg & Kwiatkowski, 1982). This is a continuous variable that can be analysed statistically (Byun & Rose, 2016).

2.6.3.3 PCC metric. PCC is a metric used to quantify phoneme acquisition and is widely used for statistical analyses. It was developed as a severity measure in studies of developmental phonology (Shriberg et al., 1997; Shriberg & Kwiatkowski, 1982). It does not concern itself with the problems of variation or the differences between phonetic and phonological inventory, assuming that the adult targets are clearly agreed. Nevertheless it has been widely used also in cross-linguistic research (Goldstein, Fabiano, & Washington, 2005; Goldstein & Kohnert, 2005). Although designed originally for use with a conversational speech sample, more structured sampling approaches have also been employed (Johnson et al., 2004; Masterson et al., 2005). As an average, PCC can also be impacted by the inevitable differences in frequency of phones in a sample, even a structured sample like a Picture Naming Test (PNT). This, plus differences in elicitation, meant that there are differences in opportunity for each phone. An inventory based on a frequency criterion, can provide more clinically useful data.

PCC is an average (Shriberg et al., 1997), so may lack specificity as its focus on consonants correct may mask the detail of specific errors (Ruiz-Felter et al., 2016;

Shriberg et al., 1997). PCC has also been linked to Early, Middle and Late (EML) categories (Fabiano-Smith & Goldstein, 2010a; Ruiz-Felter et al., 2016). Other descriptives such as the averages generated by the PCC metric and measures of variance such as standard deviation (SD) are valuable in cross-linguistic or clinical research (Yavas & Goldstein, 2006, p. 276).

Phonological studies of creole languages must consider each language's unique setting. Whilst there are commonalities in creole languages, there are important differences between, for example, Caribbean, African and Pacific region creole languages (Tryon, 2004). These differences impact, not only the nature of the creole genesis but the ongoing language function, including child phonological acquisition (Wekker, 2011).

This chapter has canvassed just some of the issues involved in measuring phonological development. This is a complex process in a monolingual setting, but multilingualism, and the inclusion of a creole language in the multilingual mix, create further complexity. Even amongst creoles there is variation in the sociolinguistic forces that contribute to the phonological aspect of language development. The unique features of Tok Pisin language function are a product of the country in which it is spoken: its history, geography, culture and sociolinguistic features. Chapter three gives a brief outline of the chief contextual characteristics of PNG which have shaped its lingua franca, Tok Pisin.

Chapter 3. Contextual Background of the Study

PNG is composed of the eastern half of the major New Guinea island, plus several large archipelagos and smaller groups of islands, totalling 600 islands in all (Simons & Fennig, 2018) (Appendix A). The isolation caused by their topography impacts social structure and language use. The large islands are characterised by central mountain spines with coastal alluvial plains which are drained by large rivers. The more temperate climate at altitude means that the large mountain valleys have an ancient history of garden cultivation supporting clan-based settlement. Populations in the large coastal river deltas and remote islands are often separated by water barriers. The resulting isolated family hamlets or nucleated village communities often each have their own distinguishing language (B. Allen, 1983).

3.1 Linguistic Setting

There are three types of languages interacting sociolinguistically in PNG (Table 1) which have quite specific domain use (Nidue, 1990; Schneider, 2015). English, the colonial Language of Wider Communication (LWC) (Kale 1990; Siegel, 1999), allows entry into the broader world (Fishman, 1969; Litteral, 2015), and is the language of education and government. The vernacular languages are spoken to varying degrees but certainly for traditional cultural events. The lingua francas are spoken for trade and other inter-tribal contact. The lingua franca role is now held predominantly by TP. There are four national languages: English, a sign language, and the two lingua franca: Hiri or police Motu, (G. Smith, 2002)

and Tok Pisin (TP); a Melanesian pidgin (Mühlhäusler et al., 2003). PNG languages have been extensively researched by mission linguists (Simons & Fennig, 2018), educational linguists (Siegel, 1997a, 2005; Wroge, 2002), and academic linguists (Bee, 1972; Crowley, 1995; Lynch, 1990; Rumsey, 2014). There have not yet been any clinical linguistic studies. TP has received attention because of its sociolinguistic importance in PNG, but there has been no developmental research in TP.

Table 1. PNG sociolinguistics.

	Category	**Language name**	**Uses**
Official National Languages	LWC	English	Education, professional workers, schools and government.
	Lingua Franca	TP	Trade, church, intertribal relations. Often in parliament
		Hiri Motu	Or 'Police Motu'. Simplified version of vernacular 'Motu'. Now limited to original southern coastal areas.
	Sign Language		Special education
Vernacular Languages		381 different vernaculars	Traditional tribal and village life.

Note: the inclusion of Hiri Motu as a national language is a reflection of PNG history more than present day sociolinguistic use.

PNG is a tribal, mainly subsistence agricultural culture, where vernacular language is linked to the clan-based social structure (Cass, 1999). The very name Tokples illustrates the importance of vernaculars, as it

literally means ‘language of place'. PNG's level of linguistic diversity may be attributed to four key factors; climatic benevolence, topography, the role of language as the primary identity marker, and the ancient history of PNG (Levy, 2005). There are two major language groups within PNG's over 880 vernacular languages: more than 200 from the enormous Austronesian language group and over 600 from the heterogeneous Papuan group of language families (Aikhenvald, 2014). Language groups are generally very small, as is the pattern throughout Melanesia, although the highlands has the largest language groups (Mühlhäusler, 1987).

English influence has grown this century with television and social media use on mobile phones. TP social media forms have also developed. English is rarely the mother tongue. Although English is essential to career advancement, it is not the first choice of most speakers. For example, it was found that amongst students at an elite high school in the nation's capital, English was only spoken at home by 6% of students (Temple, Ezebilo, Hane-Nou, & Kamene, 2017).

Multilingualism or *passive multilingualism* (Sankoff, 1977) is usual in PNG. People outside urban centres speak their vernacular and often one or two neighbouring vernaculars (Aikhenvald, 2014) as intermarriage and trading occurs between small language groups (Sankoff, 1977). As TP and English are being used more frequently in the changing culture, some of the vernacular languages are dying or endangered (Nettle, 2000). Prior to PNG's independence from Australia in 1975, only 7.7% of Southern highlanders spoke TP and over 80% didn't speak one of the national

languages (Sankoff, 1977). Today, the situation is very different and the number not speaking TP or English is negligible (Aikhenvald, 2014, p. III). An example is seen in a longitudinal developmental study conducted over 34 years immediately west of the Mt. Hagen Melpa language area. A sharp increase in TP use by age two and a half between 2011 and 2013 was observed along with a decrease in both the age of the youngest TP speaker, and the age at which parents began addressing children in TP (Merlan & Rumsey, 2015). Merlan and Rumsey (2015) also note, for example, that Mt Hagen township children are more likely to have TP as their mother tongue. This pattern may be replicated throughout semi-urban PNG.

Where the dominance of English does occur, there is also loss of both endangered vernaculars and multilingualism (Aikhenvald, 2014). Nevertheless, Crowley (1995) notes the resilience of the vernacular languages and their ability to resist language shift despite sociolinguistic pressures. Fears of language loss induced by borrowing and code-switching, he proposes, are not a threat if the grammar remains intact (Crowley, 1995). Merlan and Rumsey note, for example, that in the Ku Waru area, despite the dramatic increase in TP fluency since the 1980s, Ku Waru remains the main or only language used daily (2015).

There is pressure on other languages from the powerful minority who speak English (Temple et al., 2017). In 2013 it was announced that English would become the compulsory language of instruction in all PNG schools, at every level (Belden, 2013). However, generally there has been a decline in recent decades in both teachers' and students' mastery of English (Awagl,

2018; Merlan & Rumsey, 2015), and the exact implementation and official status of this proclamation is in question (Department of Education, 2013).

Considerable research supports the effectiveness of mother tongue and TP literacy (S. Malone & Paraide, 2011; Petterson & Petterson, 2015; Siegel, 2011; Tabouret-Keller, 1997; Wroge, 2002). Although mother tongue literacy initiatives in PNG in the 20th century were hailed internationally as successful, support for them has declined in recent years and is limited to Non-Government-Organisations (NGOs) (Litteral, 2015; S. Malone, 1997). As a result PNG primary teachers struggle to find effective ways to implement English literacy in this multilingual setting (Zeegers, 2005).

The three types of languages in use in PNG have quite specific domain use (Nidue, 1990; Schneider, 2015). English, as the LWC, is the language of education and government. The vernacular languages are spoken to varying degrees but certainly for traditional cultural events. The lingua francas are spoken for trade and other inter-tribal contact. The lingua franca role is now held predominantly by TP.

Papua New Guinea's cities have a different sociolinguistic setting to that of the rural settlements. Rural land pressures have led some subsistence farmers to migrate from rural areas to the cities' squatter settlements (Numbasa & Koczberski, 2012) and mix with more highly educated city dwellers (Jones, 2012). This increasing urbanisation of formerly rural, subsistence farmers has resulted in a complex urban sociolinguistic structure.

Amidst all this complexity the role of Tok Pisin in PNG's language equation is the one consistently dominant force (Schneider 2015). The lingua franca and second language status of TP limits the likely variation (Smith, 2002), which ensures the national viability of TP as a spoken lingua franca.

3.2 Tok Pisin

Tok Pisin previously known as Melanesian Pidgin and New Guinea Pidgin (Mühlhäusler et al., 2003) is one dialect of Melanesian Pidgin English; others are Solomon Islands Pidgin English, Bislama in Vanuatu and less vigorous forms in New Caledonia and Australia.

3.2.1 TP: History and development. In order to understand the role of TP in PNG life, it is helpful to consider its history. Tok Pisin is thought to have originated as an unstable coastal trading jargon that became stabilised as a pidgin in the plantations of the Pacific region (Mühlhäusler, 1985a). A number of historical elements: German rule and the Pax-Germanica prior to WWI (Mühlhäusler, 1985a), use of TP in the local plantations, and use of TP by the combatants in WWII (Mühlhäusler, 1985b), all led to the indigenisation and stabilisation of TP as a PNG lingua franca (Sankoff, 1977). The north coast TP described by Mihalic (1989) has significant contributions from German, including suprasegmentals, phonological rules and lexicon.

From early PNG plantation days, TP has become, not just a language that was useful for colonisers to speak to Papuans, but a language that was used by multilingual Papua New Guineans to communicate with each other

(Tryon, 2004). When urban families are formed cross-linguistically and parents don't share a vernacular, TP is used in the home as the main language. This then becomes their children's mother tongue (Sankoff, 1973). When urban children first grew up using TP exclusively at home as their native language, it began to creolise (Sankoff & Laberge, 1973).

3.2.2 Tok Pisin: current sociolinguistic dominance. Tok Pisin is evident in many domains and registers and is used by a variety of speakers. It is spoken in every province of PNG by a higher percentage of speakers than any other national language, and nationally exceeds the number of speakers of any other language (King, 2014; Romaine, 1992). Language use data can be difficult to interpret because of the various combinations of language use (Paliwala, 2012b). However, in the 2000 census, TP language use in a variety of combinations was over 50% compared to less than 10% in any other language, such as 3% for English. TP is considered free of tribal associations, especially in the highland provinces (Romaine, 1992a). Despite a lack of official support, TP is often spoken in parliament and has been used in education (Litteral, 2004; Siegel, 2005). It is used by authors, broadcasters, musicians, comedians and cartoonists (Browne, 2006). TP is a creative language full of metaphor which borrows freely in order to expand.

Recent research has shown contemporary children can be more comfortable learning in TP than in their vernacular languages (Devette-Chee, 2016). Literacy in TP in the 2000 census was 43.9% compared to 39.2% in English and less than 10% in any other language (PNG Government, 2000). Those who learn literacy in TP subsequently have

better results in every subject than English-medium learners, even in English (Siegel, 1999). TP has been standardised with its own dictionaries, a newspaper; (the Wantok 'friend'), and bible (Mihalic, 1989; Volker, Jackson, Baing, & Deutrom, 2007).

Pidgins, such as TP, are often thought to have a lifecycle; that is they develop for a purpose, then disappear or are creolised and possibly then *decreolised* or reintegrated into the lexifier language (Velupillai, 2015). There has been debate over whether decreolisation is occurring with TP and whether it will be reabsorbed eventually into English (Kale, 1990; Paliwala, 2012a; Siegel, 1997c). Siegel counters claims of decreolisation, referring to substrate influence and TP's internal resources as additional sources of change in the language (1997c). Despite extensive code-shifting and borrowing, TP retains its independence from English (Paliwala, 2012a; Siegel, 2010).

Although village settings were once isolated from the language impacts of media, and sometimes even education, this is now less often the case. Today, in village settings, the impact of education and media ensure some level of language mixing for all but infant speakers. Siegel regards TP as an extended pidgin rather than a creole, because, despite its importance, it is still the second language for many of its speakers (Siegel, 1997c, 2013). The exception are the urban children who are native speakers of TP and often merely passive receptive bilinguals in regard to their heritage languages. Within communities who live on the urban fringes, speakers

from several TP sociolects mix (Paliwala, 2012a), as well as speakers with phonologies from different substrates (G. Smith, 2002).

Mühlhäusler found TP exceptional among pidgins in that it hasn't proceeded neatly through one phase after another of pidgin life so that early and late stages of the cycle (1985a, p. 36) of the pidgin continuum are co-existing geographically, even where creolisation has begun. TP can demonstrate both synchronic (at one point in time) and diachronic (over time) differences and still maintain its effectiveness as a lingua franca for the entire country.

3.2.3 The role of language mixing in TP language change. Code-mixing is both an inevitable result of multilingual language contact and a potent driver for language change, including creolisation (Myers-Scotton, 2002). Paliwala (2012) and King assert that, in PNG, Tok Pisin is consistently the '*matrix language'* which controls the overall grammatical framework and English is the '*embedded language'* imported into the matrix (King, 2014, p. 122). Language mixing, as discussed in chapter two, can cause both ephemeral nonce borrowings (Poplack, 2012), or code shifts, and permanent changes or borrowings to a language. Haspelmath and Tadmor (2009) define borrowing as a completed language change that has proceeded over time from an individual innovation that eventually permeates the entire speech community. Children will initiate borrowings as part of the creolisation process. This process, which occurs more rapidly in small language groups (Haspelmath & Tadmor, 2009) is frequent in PNG communities.

Expansion of the phonology to include English phonemes in loanwords was recorded as early as 1955 by Hall (1955). English lexical borrowings are considered by some linguists as fully integrated into the TP phonology when they become loanwords, with morphological and phonological integration (King, 2014; Siegel, 2013). An example is the term; /blututɪm/ 'bluetoothim' for ‘to Bluetooth’ (Haspelmath & Tadmor, 2009). Substrate influence on the phonology has also been documented, for example the allophonic use of [p] and [f] in Bougainville and Highlands TP speakers (G. Smith, 2002, p. 201). Smith reports phonological integration of borrowed words in his study of neologisms in TP used on Manus Island (2002), where TP has functioned as a creole for three generations amongst plantation workers (Mühlhäusler et al., 2003). Highlands and urban coastal speakers from the acrolect; the sociolect closest to the lexifier, regularly use new phonemes imported with lexical borrowings. For example the fluent use of new phonemes in borrowed words such as the [ʧ] in keʧim] which is formed from the English word 'catch' with the TP transitive suffix 'im' added, noted in a study of TP use on mobile phones (King, 2014).

3.2.4 Tok Pisin Grammar. Tok Pisin is originally an English-lexified pidgin (G. Smith & Siegel, 2013b) and, as such, will have features of English grammar within the typically simplified structure of a pidgin (Velupillai, 2015). Like English, TP is a Subject-Verb-Object (SVO) language. This is thought to be the most common creole pattern (G. Smith, 2002).

As a pidgin, TP is less inflected than other languages but, with creolisation, expansions of its repertoire of inflections have been recorded (G. Smith, 2002). Also, although there may not be verb forms for features such as the passive voice, they can be expressed by using intransitive verbs or by circumlocution (Mihalic, 1989). Similarly, various moods can be expressed by specific word use, word order or inclusion and non-inclusion of particles (Mihalic, 1989). The verbs 'laik' (want/like/desire) and 'klostu' (almost, nearly), can, for example, be used to express the proximative case (Romaine, 1999) as in 'klostu mi pundaun' (I nearly fell). The emergence of 'bai' as a future marker is well documented (Romaine, 1990; Sankoff, 1990, 1991).

The personal pronoun system is in some ways more sophisticated than English. First person 'mitupela' (we two, excluding the interlocutor) versus 'yumitupela' (we two, including the interlocutor) (Mihalic, 1989), may reflect Melanesian sociological patterns.

3.3 Tok Pisin Phonology

Motivated by the variation implicit in TP use (G. Smith & Siegel, 2013b), a concept of core phonology (Laycock, 1985) has arisen to describe the phonological segments always likely to be present in TP phonology. There is variation around the core, with additional phones in different settings, but the core phonology rarely changes. Laycock describes 24 core phonemes, with the following core consonants: /m, n, ŋ, p, b, t, d, k, g, f, s, h, w, l, j/. Laycock also includes /si/ as a TP substitute for affricates found in English loanwords as in /sios/ ‘church’. Regional and domain variation

around the core is expected. Despite a number of studies, there is a lack of consensus regarding the core phonology of TP (Paliwala, 2012a; Romaine, 1992; G. Smith, 2002).

3.3.1 Core consonants. The most recent description by Smith and Siegel (2013b) identifies 18 core consonants as major allophones, qualified with [ʃ] and [tʃ] which are only used in loanwords. Mihalic's phonology (1989) of 23 phonemes was used by Geoff Smith (2002) in his research into native TP speakers, with seventeen consonants and five vowels as the 'standard of comparison' (Smith, 2002, p. 44). He uses this core phonology of 17 consonants for his transcription: /p, b, t, d, k, g, n, m, ŋ, v, s, f, h, l, r, w, j/ (G. Smith, 2002, p. 44), which we have also adopted for this research, as shown in Table 2. The bracketed emergent phonemes are /f/, /ʃ/, and /ʧ/ are emergent in all positions. Fricative /v/ is established in SIWW position, and emergent in SFWF position, /ʤ/ is established in SIWI position and emergent in SIWW and SFWF positions.[1]

[1]*Where possible square brackets are used to denote phones and allophones and slashes denote phonemes. This is because some phones introduced through loanwords to Tok Pisin are transitioning from allophones that may evolve into phonemes with regular use.*

Table 2. Tok Pisin Core Consonants

	bilabial	labio-dental	alveolar	palatal	velar	glottal
Plosive	p, b		t, d		k, g	
Affricate			(ʧ)dʒ			
Fricative		(f)(v)	s (ʃ)			h
Lateral/ approximants	w		l	j		
Trill/flap			r			
Nasal	m		n		ŋ	

Note 1: Phonemes in brackets; /f/, /ʧ/ and /ʃ/ are emergent, with distribution limited to loanwords.

Speakers of English may realise a TP core phonology item in more than one form. They may introduce new phones from English. For example, Smith recorded an 11 year old child from the Eastern highlands province who used the English /ð/ rather than /s/ in the coda position for the word 'clothes' (G. Smith, 2002, p. 45). Although unaspirated plosives are more usual, some English speakers will sometimes aspirated unvoiced plosives. Different substrates will also result in different varieties (Paliwala, 2012a). The influence of the Tolai language, is seen for example, in the prenasalisation of voiced stops with new Britain speakers; as in when [dai] becomes [ndai](Goulden, 1989, p. 70). Paliwala (2012a) also adapts Laycock's core phonology to summarise the phonology, but adds the English consonants /ʃ/, /ʒ/, /ʧ// ʤ/ and /z/ which Mihalic's north coast

standard excluded. Smith and Siegel describe their summary as an idealisation because of the high level of variation they have recorded (2013a). This is caused by two factors: substrate phonologies and the impact of English. It is exemplified by variation generally evident in the production of /l/-/r/, /s/-/t/, /p/-/f/ and voiced/voiceless stops (Smith & Siegel, 2013a, p. 5).

3.3.2 TP Core vowels. There are five vowels described by Laycock (1985) which are consistently included in the phonology core group (G. Smith & Siegel, 2013b). However, Laycock (1985) indicated that the core number of five vowels and six diphthongs could vary, depending on the individual speakers' substrate and English influences. The five core vowels are shown in Table 3. Mihalic also includes four allophones [i] to [ɪ] and [ʊ] to [u] (1989, pp. 4-6). Four diphthongs were also used by Smith in his transcription: [ai, au, iu, ɔi] (2002, p. 44).

Table 3. Tok Pisin Core Vowels (Laycock, 1985; Paliwala, 2012a)

	Front	**Central**	**Back**
Close	i		u
Mid	e		o
Open		a	

Note: Although five core monophthongs vowels are agreed upon in all the literature, the number of diphthongs quoted varies. Their contrastiveness requires further research.

3.3.3 Syllable structure and stress. TP is not a tonal language and equal stress patterns are the default. The syllable structure is consonant - vowel (CV) or consonant-vowel-consonant (CVC) with fewer expansions than English. Complex syllable onsets may be observed, but codas are typically simple: C (0-3) VC (0-1) (Smith & Siegel, 2013b). Coda clusters from loanwords, such as 'nd' in 'island' drop the final consonant in coda position, which results in /ailan/ (Mihalic, 1989, p. 8). Polysyllabic words are often formed by the addition of well–used suffixes such as 'im' the transitive verb marker, or 'pela' the adjectival suffix, but this latter is often abbreviated to /pla/ in creole forms (Smith, 2002). Compound words such /mauspas/,' mute' are another major other source of polysyllabic words. Thus, for most polysyllabic words, pronunciation is facilitated by the syllable structure.

The impact of substrate languages' prenasalisation of stops, on the other hand, creates clusters, as with /tambu/, 'taboo'. The impact of substrate prenasalisation of stops , which has changed source words such as /tabu/ 'taboo' to /tambu/ (Mihalic, 1989, p. 191) does not always result in clusters, but the introduction of a nasal consonant which is separated by a syllable break. Exceptions are ephemera or variants such as [ndai] 'die'. Mihalic's dictionary, for example, lists both [dai] and [ndai] as options.

Not all phonemes occur in all positions in the same way in TP. Phonotactic rules, for example, dictate that voiced obstruents are not present in coda position and that the affricate /dʒ/ and glide [j] are only used word intially. A brief chart of the distribution of TP phones, based on the literature

which was the point of reference for phonotactic analyses, is outlined in Table 4.

3.3.4 Universal Constraints on the Core Phonology. Tok Pisin phonology may demonstrate pressure to eliminate marked segments according to universal constraints (Romaine, 1992). For example, Mihalic's TP dictionary (1989) has the plosive [p] replacing the more marked fricative [f]. Tok Pisin short vowels are in harmony with many of the world's languages, in that they occupy the extremes of the vowel space (Paliwala, 2012a), a pattern which Ladefoged and Disner describe as an evolutionary feature that distributes the vowels efficiently (2012).

Table 4. Tok Pisin Phonotactics.

	Onset	**Coda**
Nasals	Blends with /s/ allowed for /n/ and/m/	Loanwords with blends tend to be reduced to single consonants, e.g. /stɪŋk/ 'stink' becomes /stɪŋ/
Plosives	Voiced and unvoiced	Unvoiced only. E.g. /bet/ 'bed'
Fricatives	No interdental fricatives. Unvoiced alveolar replaces /z/, /ʃ/, /ʒ/. Glottal fricative /h/ exists as a major allophone. No voiced alveolar. No post alveolar fricatives. /ʃ/ in loanword only.	No interdentals Unvoiced alveolar in place of all fricative categories.
Affricates	Unvoiced /ʧ/ only in loanwords. Voiced /ʤ/ limited use.	replaced by /s/
Approximates	/j/ established. Substrate and English origins.	
Clusters	Complex onsets permitted, epenthetic vowel insertion in loanwords e.g. /sɪmuk/ 'smoke'.	Simple codas only permitted, elision of final consonant in clusters e.g. /han/ 'hand'

The core phonology of Tok Pisin as a pidgin, in common with all the Melanesian pidgins, showed some reductionist features, often following universal constraints. These included the reduction of the English fricatives /s/, /z/, /ʒ/ and /ʃ/ to /s/, a replacement by the least marked sound of the set (Plag, 2009). There is also a reduction for the affricates /ʤ/ in coda positions and /ʧ/ to the least marked /s/. A similar move to unmarked choices is seen in the neutralisation of /θ/ and /ð/ to /d/ and /t/ and /θ/ to /t/ (Plag, 2009).

3.4 Tok Pisin: Impact of Creolisation

The creolisation process began for TP in the early 1970s when the acquisition of its first native speakers was recorded (Sankoff & Laberge, 1973). Romaine argues that the universal pressure seen in pidgins to remove marked segments is being changed with creolisation, so that contrasts are expanding to make the phonological inventory more like that of English (1992, p. 181). English, as the main lexifier of Tok Pisin, has been the source of much lexical borrowing as creolisation has progressed (Brash, 1971, 1975; Romaine, 1992) and it remains to be seen how this will impact phonological change.

3.4.1 Borrowing. Borrowing of a lexical item can result in several outcomes (Matras & Sakel, 2007): 1). No change to the recipient phonology, instead conforming to TP phonology. The child who calls a carrot [kerot], imposes TP vowel use on the English word by changing [æ] to [e]. Also, the insertion of an epenthetic vowel in onset clusters, was seen in early TP

adoptions to change the syllable structure to match a simpler phonotactic pattern. 2). A temporary change limited to the borrowed word, as with [fleks] 'flex' (mobile phone credits) or the child who uses [ʤizaz] (Jesus), changes her TP phonological rule enforcing /s/, to use the English [z]. There are also recorded examples of the dental fricatives, as in /θawzən/, 'thousand'. New clusters; as in coda /ld/ in 'gold' (Smith, 2002, p. 52) have been recorded. 3). Permanent changes to the phonotactics or phonology of the language: The use of the English borrowing [ʤɪnʤa] (ginger) reflects a broadening distribution of the voiced affricate to include the medial position allowed with English. Thus, adoption of English words can incrementally change the recipient TP phonology.

3.4.2 Changes to phonology with morphophonological condensation.

As the functions of creole TP expanded, so has its structure, as is usual with creolisation, which reverses the simplifications of pidginisation (McMahon, 1994). For example, the condensation of the count noun /tupela/ 'two' to /tupla/, whilst reducing the number of syllables, introduces consonant clusters within the syllable. This process is referred to as *morphological condensation* (Romaine, 1992) or *morphophonemic reduction* (Smith 2002). Well-entrenched examples are the reduction of the adjectival suffix 'pela' to 'pla' or 'bilong' to 'blong' (Smith, 2002, p. 54) or even blo', and demonstratives 'dispela' (this) to 'disla' or pronouns 'mitupela' (we two) to 'mitla' (Romaine, 1992; G. Smith, 2002). This process contrasts with the pidginisation process of the removal of clusters by epenthesis as discussed above.

3.4.3 Expansion to the phonology with creolisation. As a result of the segmental phonological expansion with creolisation, a number of new phonological contrasts have been observed in some population's Tok Pisin phonology (Romaine, 1992), but it is not yet clear how applicable they are to the core phonology. These include [p] contrast to [f], [r] to [l], [h] to [ø] and [s] to [tʃ] and [ʃ]. Romaine noted /ʃ/ and /ʧ/ emerging in coastal children, more frequently in older children (1992). In addition, Smith noted examples of [θ], [ʒ] and syllable final /ʤ/, albeit in very small numbers (2002). Both Smith and Romaine found that /f/ was emerging with speakers' contact with English, so that there was considerable variability with English loanwords containing /f/ often being pronounced with [f] rather than TP [p] (Romaine, 1992), but less so in the highlands (G. Smith, 2002). Romaine (1992) and Smith (1992; 2002) are the most comprehensive and recent sources documenting these changes, but their work is not considered contemporary. More current child studies are now needed, especially with the impact of technology and social media (Harvey, 2007; King, 2014; Watson & Duffield, 2016).

Sometimes the source of phonological expansion during creolisation may be the substrate. Thus the new language is formed with features from both the lexifier or superstrate language and the substrate vernacular (Grant, 2009). Creole researchers agree that substrate languages clearly contribute to formation of creoles, and that understanding the substrate language is part of understanding the creole (Mufwene, 1984, 2015). However, in PNG it is impossible to limit speakers to just one substrate, except in the more isolated

remote settings, because inter-clan associations may introduce new languages into the sociolinguistic equation at any time.

In the target population of this study, it is also not possible to definitively describe the exact contribution of the three types of contributing languages to each child's phonological competence. Each child receives a unique combination of each of the three language types available in highlands PNG: English, the vernaculars and TP. Each family group, and potentially each child, has different levels of competence in each language type. This will depend on both the sociolinguistic function of each language type in the child's community, and their age of exposure and practice of each language type.

3.5 Melpa Language

The substrate language of the research population is Melpa language spoken by people in and around the wider Mt Hagen area. Melpa language is the second biggest vernacular language group in PNG after the Engan language (Stewart & Strathern, 2018). The larger languages in PNG tend to enlarge through contact. When there is contact with adjacent smaller languages, those groups tend to become bilingual (Sankoff, 1980) and boundaries blurred.

Melpa is a Papuan language and is part of the Trans New Guinea (TNG) phylum. This group of languages has several features also seen in TP. They have a syllable structure with few clusters, although complex and ambiguous co-articulations occur (2010; Stucky, 1990). The prenasalisation of stops, seen in words such as 'tambu' (taboo) is also a common TNG

phylum feature (Reesink, 1987). Many creolists suggest that the highest level of influence occurs from the substrate at the point when the pidgin becomes a creole and expanded functionality is required by those for whom it is their native language (Siegel, 2003). Melpa is still widely used by the research participants in our studies and this may impact their phonology.

3.5.1 Melpa phonology. Melpa phonology is shown in Table 5. Melpa is characterised by contrastive dentalisation, prenasalisation of stops and unaspirated voiceless stops. Melpa is known for its range of laterals which include lateral fricatives (Ladefoged, 2001; Ladefoged & Disner, 2012; Ruby, 1990). Ladefoged identified six Melpa laterals which occur contrastively in three positions; dental, alveolar and velar. Prior to this discovery, velar laterals were not thought to be possible. The allophonic alveolar lateral is fricative, and devoicing of laterals which occurs in final position results in phones which are 'effectively unvoiced lateral fricatives' (Ladefoged & Maddieson, 1996, p. 191). Melpa velar laterals may also be pre-stopped (Ladefoged & Maddieson, 1996, p. 195). The substrate consonants with the potential to impact TP speakers near Mt Hagen are very different to TP Anglophone consonants. Examples like this, where there is greater language distance, are thought to predict less enduring phonological interference (Siegel, 1999). Table 6 compares the three main languages of our participants, illustrating the significant difference between English and Melpa phonology.

Table 5. Melpa Consonant Phonology.

Place Manner	Bilabial	Dental	Alveolar	Velar
Oral Stop	p	t̪	t	k
Prenasalised Stop	/ᵐb/	/ ⁿd/	/nd/	/ŋg/
	[mp]	[nd̪]	[nt]	[ŋk]
Nasals	/m/	/n/	/n/	/ŋ/
	[m]	[n̪]	[n]	[ŋ]
Approximants	/w/	semi vowels	/j/	[ŋ]
Liquids		ɬ	/r/	
			[r̃ ɾ̌]	
		/l/	/ld/	/L/

Note; Adapted from Melpa consonants (Ruby, 1990; Stewart & Strathern, 2018) with contributions from Ladefoged and Maddieson (1996).

Table 6. Cross linguistic Consonant Inventory Comparison: English, Melpa, Tok Pisin (Smith & Siegel, 2013; Stucky, 1990)

	Consonants in Common	Consonants Unique to English	Unique to Melpa	TP
Plosives	p, b t, d k, g Aspirated allophones		[t̪]	None unique.
Prenasalised Plosives			ᵐb, ⁿd unvoiced allophones	
Fricatives/ Affricates	f, v, ʤ	θ, ð ʃ, ʒ ʧ,		
Lateral Fricatives			ɬ, [l̪]	
Laterals	l		ld, L(velar) [l̪t], [lt], [l̪]	
Nasals	n, m, ŋ			
Approximants	w, j r	ɹ		

3.6 Cultural Context

Cultural context can impact a wide range of behaviours from speech to the ways knowledge is communicated in a culture. In the past, the bias in research focus to the privileged western cultures has tended to allow the assumption that culturally-based European preferred patterns of learning are universal. This is changing as sociolinguistic studies illustrate how cultural bias can reduce objectivity (Xiao, 2006). Differences in linguistic environments can lead to early acquisition of structures and segments that in another culture would be considered later developing. Children's language acquisition reveals what is particular to their language and linguists have recognised the importance of seeking a data base that is outside the cultural and theoretical assumptions of their dominant experience (Pye, 1988). In any study within cross cultural contexts, it is important to consider world view, discourse styles, power structures and expectations.

3.6.1 Cultural style of PNG. Gaining access to the Mount Hagen community required understanding of where the power lies, how it is distributed and its expression in gender roles and symbolic exchanges. It was important to gain a practical knowledge of highlander culture as it is inextricably connected to language use and development. The culture impacted every aspect of the research process, but particularly, obtaining participants in a culturally appropriate manner, obtaining cultural advisors and support in implementing data collection and analysis, and choices about which factors to measure, such as gender differences. We sought to

implement our research in a culturally appropriate fashion, as outlined in section 4.2.5

PNG is a *high power* culture in terms of authority structures and social interdependence (Westby, 2009). Melanesian is one of a group of cultures which values relationship over clarity or efficiency (Lanier, 2000). The culture is clan-based, and this primary determinant has impact at all levels of society (Bartle, 2005; Dorney, 1990, 2018; Thiele, 2013). The power base in Highland clans sits with the male elders (Thiele, 2013) and therefore their support is crucial. As an *exchange* culture (Howley, 2008; Thomas, 1991), material objects and information can be exchanged for influence (Strathern, 1973). Highlanders are uncomfortable both with giving something freely or not being able to repay a gift. They remember and negotiate complex exchange arrangements, elements of which may last decades. Information is also part of the exchange. Exchange means that one is welcomed warmly as a potential contributor to the community.

3.6.2 Gender in PNG culture. Although parts of PNG are matrilineal, highlands clans are patriarchal, and highlands women mainly contribute to clan life in their management of the family agricultural holdings. In PNG, gender discrimination is an integral part of social functioning (World Bank, 2012), playing out in safety issues for girls and women (Human Rights Watch, 2019), inequity in education, the workforce (Ciobo, 2015; Thiele, 2013) and government representation (Wood, 2016). The Australian administration made universal education a goal (Lewis, 1971), and now with gender equality a third millennium development goal (Spark, 2011),

the situation is slowly changing as some girls obtain tertiary qualifications. Nevertheless, the culture endorses women as silent, compliant servers who are still being bought and sold in marriage. Some educated women are now avoiding marriage (Spark, 2011).

It is men who speak out at public meetings, women generally remain silent and their needs can only be made known behind the scenes. This traditional lack of female voice is reflected in negotiations in PNG communities (Popoitai & Ofosu-Amaah, 2013). Public speaking is a very important male skill, highly valued for its ability to gain a man financial support in the *moka* gift exchanges and politics crucial to *big man* status (Connolly & Anderson, 1983; Stewart & Strathern, 1998). The subservient role of girls and women and the interdependency of the PNG village social structure means that children and young adults are unlikely to act outside the social structures which their parents and elders model (Hinton, 2009; World Bank, 2012). Thus, young girls may be reluctant to speak out in communal contexts. Further research is required to identify how this may impact their language outputs in all domains.

3.6.3 Cultural factors impacting child language and learning. In PNG, children learn by observing and doing. There is rarely any direct instruction for new skills such as participating in traditional dances, weaving housing materials or killing a pig. Children learn by observing, and imitating when they are allowed to. The same pattern persists in their schooling, and children who can't learn by imitation are unlikely to thrive in school. By grade three, prep class sizes have halved (Tryon, 2004). Tasks

where their performance as an individual are the focus, are strange and intimidating for children (Lancy, 2010) and the administration of picture naming tests must accommodate this cultural feature. Cloze task and contextual prompting may intimidate the children.

3.7 Linguistic research in TP.

PNG's status as the most linguistically diverse country on earth (Jenkins, 2005; Smith, 2002) has generated great interest in the last century (Crowley, 1995; Wurm, 1979). However, none of the linguistic studies conducted in PNG have had a clinical element. There has been language documentation by missionaries such as the Summer Institute of Linguistics (SIL) and academic typological studies (Appendix B). As a result, syntax, discourse and pragmatics have been better covered than phonology (Major, 1998). A few exceptions are studies of specific language groups (Bee, 1972; Raymond & Parker, 2005; Rumsey, 2014, 2017) and orthographic studies supporting local literacy (D. L. Malone, 1998; S. Malone & Paraide, 2011). Tok Pisin has received attention because of its growing importance and changing role but developmental phonological studies have never involved a clinical focus (McElhanon, 1975; Sankoff, 1973, 1973b; Wurm & Mühlhäusler, 1985). A relatively recent study of creole TP speakers, which includes phonological data of adolescents, suggested that studies of child phonological development were needed (G. Smith, 2002).

3.8 Purpose and Importance of Current Study

This study is the first clinically focused linguistic study of PNG. PNG's prolific history of linguistic research is limited to structural and

descriptive studies either for the purpose of literacy (Tabouret-Keller, 1997) or topological categorization. This study will begin to provide insights into phonological developmental in the sociocultural context in the Highlands of Papua New Guinea. Data on any language contributes to the understanding of what language is and how it functions. Thus, this work will contribute to the worldwide knowledge of language, and specifically contact languages, contributing to the data related to universal features of phonology. It will contribute to knowledge of current child phonological use including the degree to which creole TP learners integrate phonemes acquired through borrowing.

This preliminary study will also contribute to the process of understanding culturally and sociolinguistically appropriate strategies when carrying out research in PNG. Existing longitudinal and observational studies have begun to clarify the sociolinguistic picture in this complex setting. However, cross-sectional developmental studies are needed to add to the existing studies to clarify the sequence in which children acquire phonology, how their multiple phonologies interact, and when it may be appropriate to provide support in the learning process. The current research seeks to understand children's acquisition of TP phonology and to examine the occurrence of phonological processes in order to support best practice for diagnosis and treatment of speech disorders (Sreedevi, John, & Chandran, 2013).

The study will ask the following questions:

In TP Creole-speaking children aged 3;0 - 3;11, 4;0 - 4;11, 5;0 - 5;11, 6;0 - 6;11:

1. Are there differences in the phonetic and phonotactic inventories between each of the age groups?

Hypothesis: It is predicted that the phonetic and phonotactic inventories of TP Creole –speaking children will increase with age.

2. Are there differences in the phonological inventories between each of the age groups?

Hypothesis: It is hypothesised that phonological inventories will expand with age.

3. Are there differences in phonological processes used by children in each of the age groups?

Hypothesis: It is hypothesised that phonological processes will decline with age.

4. Do the patterns of phonological acquisition in Creole Tok Pisin speakers reflect Universal principles as seen in phonological processes and precedence for unmarked consonants?

Hypothesis: The order of acquisition of TP Creole phonology will reflect universal principles of phonological acquisition demonstrated by phonological processes and the precedence of unmarked phonemes and processes.

5. Are there differences in this population between the phonological acquisition patterns of boys and girls?

Hypothesis: There will be differences in the phonological acquisition of boys and girls.

In order to address these questions, it was necessary to look carefully at TP usage of adult speakers in this context, a semi- urban setting in the Western Highlands of PNG, and to develop a culturally appropriate speech sampling tool. The procedures involved in addressing these two needs are described in the following chapter.

Chapter 4. Preparing the Research: Cultural Adaptations, Adult and Child Pilot Studies

4.1 Ethics Statement

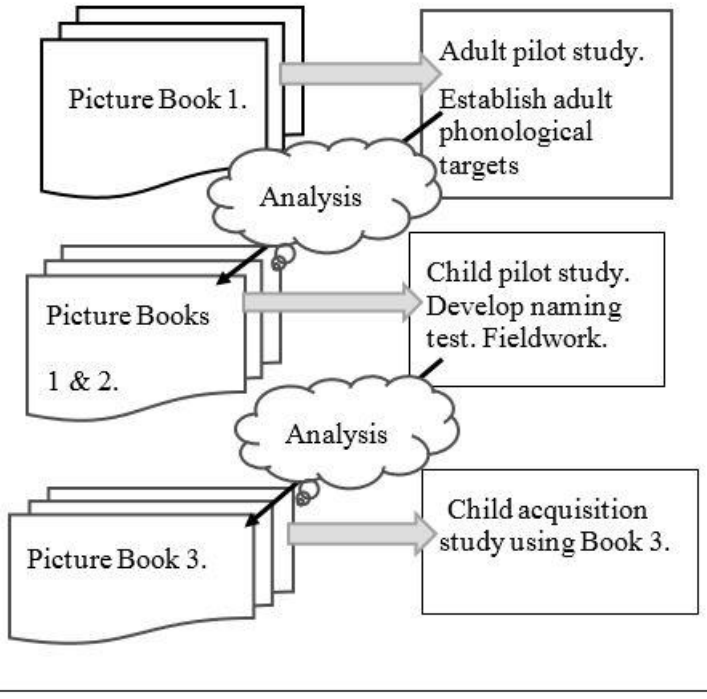
Ethical approval was obtained through the Curtin University Human Research Ethics Committee (RDHS-85-15). In addition to HREC clearance received on 26.05.15, a police clearance was sought and obtained from the PNG Royal Constabulary in 2015.

4.2 Pilot Studies: Instrument Design

This research, because of its preliminary nature for clinical linguistics in PNG, required pilot studies to inform the materials and process of the child cross-sectional study. There is considerable variation over time and place in TP; usage varies significantly along domain, substrate language and geographical divides, as well as diachronically. Therefore, the first study, the adult pilot study, confirmed the TP phonology recorded in the literature with a sample of adults from the local population. This pilot study contributed the phonological targets for the child cross-sectional study. It ensured that the phonological sampling tool, developed in the child pilot study, would include a valid and comprehensive selection of the phonological repertoires of the participants in phonotactically appropriate positions. The design of the sampling task from conception through testing in fieldwork and final preparation, leading into the cross-sectional study, is outlined in Figure 1.

The child pilot study followed the adult phonological survey. The second pilot study was necessary for the development of a data collection instrument. The lexical, pictorial and phonological content needed to be suitable for this population as much as possible whilst being accessible for three to 6-year-old children.

Figure 1. Flow Diagram of Pilot Studies.



Creating a sampling tool was an iterative process. Every step of the task development informed subsequent steps, as shown by Figure 1. A series of three photo books were developed and field-tested in turn. The adult pilot study, in addition to confirming local phonological use, enabled field testing with adults, as well as some children, for the first book. The first book was explorative, as well as sampling phonology, it aimed to discover what words the pictures

would elicit. Subsequently books one and two were field-tested with a total of 17 child participants. Book three was the culmination of the field testing process and was also field-tested on four participants prior to use in the larger child study. Thus, with each successive book, the goal was to further refine the opportunities to elicit phonetic content as well as non-phonetic elements of good test design (Grunwell, 1987).

4.2.1 Validity and reliability. Reliability and validity are key features of any test design (Flipsen & Ogiela, 2015). In majority world settings such as PNG, where there is often no precedent for phonology testing, a first measure must be created (Mahura & Pascoe, 2016). The naming tool developed in this pilot study is preliminary but makes all possible attempts within the constraints of time and resources to observe relevant validity and reliability criteria, as outlined below. The theoretical constraints on test design were considered and then applied as far as it was logistically possible, within the PNG context.

Reliability is a measure of the tool's consistent ability to give the same result when the same skill level is being examined (Burns, 2000). Reliability is often measured by comparison to an existing external measure, sometimes called a gold standard, against which a tool's reliability, could be tested (Carmines, 1979; Goodwin & Leech, 2003). In this preliminary study there was no access to a gold standard. However, conceptualisation involved considering the design principles of valid similar tools developed for other

language populations (Carter, Lees, Murira, Gona, & Neville, 2005; Edwards & Beckman, 2008; McLeod & Verdon, 2014).

Validity is a quality of an instrument whereby it measures what it was intended to measure (Carmines, 1979), in this case, TP phonology. Two validity criteria, content and construct, were combined to create a fit for purpose tool. The goal was to ensure valid content of phonological targets, vocabulary and valid construct in terms of format and phonetic opportunities. Two crucial constraints on content and construct which were considered, were the phonetic and non- phonetic constraints (Grunwell, 1987).

4.2.2 Phonetic constraints in designing a child test. Phonetic content was addressed by confirming the phonology in the adult pilot study. Optimal representation of the phonetic content in a variety of syllabic positions was addressed through the target word choices. The sampling tool was designed to record each TP phoneme in all syllabic positions allowed by TP phonotactic rules (Table 5). Phonologically the impact of other languages in the multilinguistic phonological mix, the substrate Melpa and English, contributed to phonological variation in this creolising language. Different substrates can alter local phonetic content (G. Smith, 2002)

4.2.3 Non-Phonetic constraints. The non-phonetic constraints were the format and design of the sampling tool, vocabulary of test items and the pictures representing them. Carter et al. identify five key non-phonetic factors in the development of assessment tools cross- culturally (2005). These are: 1. The influence of culture on performance, 2. Familiarity with the testing situation, 3.

Formal educational opportunities, 4. Language issues and 5. Picture recognition. This study undertook to respond constructively to each of these variables in construct design and during word and picture selection.

4.2.4 Sampling format. The format of phonological data collection for SLP has most commonly been a choice between conversation sampling and picture naming tests (Masterson et al., 2005). The ability to structure a PNT to cover all phonological targets, and the ease of glossing and transcribing a known target, along with the word's speed and ease of elicitation, contributes to data consistency. Although a PNT is unable to reveal the load of connected speech processes and is biased toward nouns and adjectives, the expediency of word-based picture naming tests means they have been widely used in clinical research, even in non-English-speaking and majority world contexts (Gangji et al., 2015; Maphalala et al., 2014; McLeod, 2007). A survey of assessment tools in languages other than English and that included a 'single word assessment of speech production' (McLeod & Verdon, 2014) was able to analyse 98 different instruments.

When comparing picture-naming tasks with conversational analysis, Wolk and Meisler (1998) found that, both measures revealed similar severity ratings. However, they found that with good design, a Picture Naming task (PNT) may allow deeper and more efficient phonological analysis than conversational samples, and can be considered a good measure of children's phonological ability (1998).

4.2.5 Balancing phonetic and non-phonetic constraints. There was a need to balance the phonetic criteria and the non-phonetic criteria of the test

(Grunwell, 1987). Content validity, for example, may demand that, to fully explore articulatory competence, the tool measure every phoneme in every possible phonetic context, free of possible complications such as assimilation or elision of segments due to their phonetic environment (Grunwell, 1987). This entails a very large word sample and is likely to unduly tax both the vocabularies and the stamina of younger children who are the focus of developmental phonological studies. When stamina and the level of spontaneous elicitation due to vocabulary size are considered, what is appropriate content for adults and older children, may not be for young children (Edwards & Beckman, 2008). Unfamiliarity with the test experience may further tax young PNG TP speakers.

We decided that inclusion of some multisyllabic words was a priority. It has been shown that multi-syllabic words afford an extra refinement to phonological testing (Mason, Bérubé, Bernhardt, & Stemberger, 2015). Lack of facility with polysyllabic words has also been linked to delays in literacy and vocabulary acquisition (James, 2006; Masso, McLeod, & Baker, 2018). The phonological contexts required included some words with consonant clusters, and polysyllabic words. Such demanding items are the most likely to highlight processes occurring in articulatory and phonological development.

4.2.6 Cultural impact. Cultural impacts are a key non- phonetic constraint. Our conduct in each stage of the research (Figure 1) needed to be such that the research activity was received by parents and children as something that belonged and was a welcome addition to their lives. This

next section outlines some adaptions made within our research to accommodate the culture, initially in the pilot studies and fully implemented in the child cross-sectional study.

4.2.6.1 Community liaison. The culturally appropriate entrance into the lives of children and their parents was approached with consideration of the clan and community structure and the authority of clan leaders, rather than nuclear family units. It was appropriate to meet families in community events in which their leaders had control, or when in more urban settings, to engage the leaders, or *big men* of the community (Ketan, 2004; Macleod, 2012). The explanation of the project to each community was an opportunity for the men to respond, in the order in which their leaders deemed appropriate.

A more personal relationship was also important. Although it was culturally appropriate to address the group at the events where consents were gathered, this was preceded by casual meetings, listening over many months to stake-holders, and time spent understanding the priorities and concerns of each community. Investment in the community is important in this exchange culture. This continued once the research began, with contributions outside the scope of the project, but within the communities and the institutions involved in the project. Both informal and formal communications continued throughout the project and after the project was complete. This could be as simple as driving women to market and sharing of resources, up to participation at pre-school graduation ceremonies, formal

visits to communities, and visits by community elders to the researcher's home.

4.2.6.2 Role of the research assistant in cultural access. Due to the complexities of the PNG context, this research would not have been possible without the contribution of a member of the local community. A local woman, fluent in English, Tok Pisin, Melpa and related adjacent Tokples, filled several roles in this project. She assisted the researcher to gain access to key local players, supported parents as they gave written informed consent to participate in the project and helped complete language and education questionnaires. She also administered the picture naming task to the children, putting children at ease and later providing a native speaker's perception of the child's speech output as part of inter-rater reliability during transcription. Her cross-cultural advice to the researcher gave a local cultural perspective.

4.2.6.3 Familiarity with the testing situation. There are very few children's picture books in PNG and looking at books together is not a familiar family activity. Also, individual performance tasks are unfamiliar to children. Children learn by observing and imitating when they are allowed to (S. Malone, 1997). Tasks that focus on individual instruction and performance are strange and intimidating for children (Lancy, 2010). An instrument involving group performance was not appropriate to the goals of the research, so the need for individual sampling was a cultural difference that had to be accommodated in the style of administration of the tool to children. Strategies included in the research design were community

negotiations and discussion prior to data collecting, group practice in naming tasks, seeing the younger ones in pairs if they were nervous, and presenting the material through the research assistant.

As much as possible, data collection needed to resemble a recognisable community event, so shared food and conversation were also part of the process. Children were given opportunities, both at community gatherings, and in class, to look at, name and discuss the photographs in the picture books. The support of the local research assistant was essential in helping the children overcome the unfamiliarity of the task.

4.2.6.4 Picture recognition. The obvious need for children to be able to recognise pictures and the essential skill of picture-naming in order to respond accurately to a Picture Naming Task (Carter et al., 2005; McLeod, 2012), cannot be assumed in PNG. Pictures needed to have familiar, recognisable content to elicit the designated target word. Pictures are unfamiliar material in PNG, but, in the past decade, the advent of smart phones has made photographic material more accessible and familiar. Locally sourced photographs and pictures taken on the day were shown in early visits to village gatherings prior to commencing research. They elicited great interest from both adults and children. It became apparent that locally sourced photographs were effective stimulus materials. Most of the photographs were sourced in the children's local area. Photographs from other settings tended to confuse the adults as well as the children, and their unfamiliarity was a distraction. Maximising content that was likely to be spontaneously elicited supported reliability and content validity.

Reliability was sought through internal consistency (Ahmadi et al., 2018) facilitated by the maximum elicitation rates for words and pictures. This also supported the goals of a valid tool. High elicitation rates would indicate that it is the phonology, not the vocabulary, or any other variable, such as social confidence, being measured. This required discovery of the most easily elicited words, which was part of the task of field-testing the three books. Consistency was also sought in the method of administration with the same introductory explanation and request to 'stori bilong mi lo dispela' (tell me about this) or 'em i wanem?' (What is this?).

Consistency was also supported by allowing prompting when the target word was not elicited spontaneously. The importance of some less readily elicited content, means many researchers allow prompting (Dodd et al., 2003). In particular, studies of child phonology which include polysyllabic word targets generally allow prompting when it is needed (Masso et al., 2018). Some researchers have used imitative tasks throughout to guarantee a homogenous sample for analysis that can be efficiently sourced (Johnson et al., 2004).

4.3 Adult Pilot Study

This adult pilot study has been published previously under an open access policy, (Boer & Williams, 2017)(Appendix P). This section, of necessity, will cover much of the same content.

4.3.1 Purpose. The aim of the adult pilot was to confirm or modify the phonology in the literature with the local adult population. It also sought to refine the stimulus picture book.

4.3.2 Method.

4.3.2.1 Adult Participants. Participants were adult Tok Pisin speakers in Mt Hagen and environs who were also speakers of the Melpa substrate language. A convenience sample of 15 participants was obtained from amongst the communities centred on the schools and centres which participated in the child development study, plus some staff at the Mt Hagen Provincial Hospital. Twelve participants (1-5, 7, 9-16) remained following removal of three adults: one because of excessive background noise in the recording, one whose community perceived his speech as delayed, and a third whose performance may have been interrupted by illness. Participant characteristics are displayed in Table 7.

English use can be categorised as professional or conversational, which also gives an indication of proficiency. Professional speakers of English are those who have obtained a tertiary qualification with English as the medium of instruction and who are expected to use English professionally in their occupation. Tertiary educated professionals in PNG have been learning in English since grade three and are expected to have enough competency to use English in their professional life. Conversational speakers of English will have had some English education but do not function daily in English except at a basic conversational level. Tok Pisin is an essential part of cross tribal communication and in many professional settings such as medicine and teaching, requires fluency and cross tribal insight. The speaker must be aware of the different cross-tribal sociolects and use them confidently. The level of ability in TP and English is a product

of the standard of language exposure and teaching as well as participant's innate linguistic skills.

Ages are often difficult to confirm in PNG because date of birth isn't always recorded or remembered, so some ages given here are approximate.

Table 7. Adult Participants.

Gender	Age	Occupation	Observed [iii] language use.	Education level
M	35+	Senior teacher elementary	Melpa (mother tongue), TP, Professional [i] English	Tertiary
M	20+	Junior elementary teacher	Melpa, TP, Professional English	Tertiary
F	30+	Elementary teacher	Melpa, TP, Professional English	Tertiary
F	30+	Elementary teacher	Melpa, TP, Professional English	Tertiary
F	30+	Elementary teacher	Melpa, TP, Professional English	Tertiary
F	40+	Senior Teacher elementary	Melpa, TP, Professional English	Tertiary
F	25	Community member	Melpa, TP, Conversational English[ii]	Grade 10
F	43	Community member	Melpa, TP & Conversational English	Primary school only
F	25	Qualified nurse	Melpa, TP, Professional English	Tertiary
M	50	Pastor, community setting.	Melpa, TP, some Professional English	Diploma
M	25	Physiotherapy resident	Melpa, English and TP used equally	Tertiary
M	27	IT professional	Melpa, TP and Professional English.	Tertiary

Note 1.[i] 'Professional language user' – linguistic facility required for a professional work setting, usually associated with tertiary education.
Note 2. [ii] 'Conversational English'- A more colloquial form of English. Enough English to converse but not use with authority in a professional context (such as in education or medicine).
Note 3. [iii] 'Observed Language Use'. Observed by researcher in communication with the participant.

4.3.2.2 Materials. Speech samples were elicited using the first photo book, Book1, which was specifically designed for this research as a targeted word-naming task. The first picture book comprised 62 labelled pictures with multiple target words per picture. A comprehensive range of target phonemes was based on the literature available (Laycock, 1985; Mihalic, 1989; Mühlhäusler et al., 2003; Romaine, 1992; Smith, 2002; Volker et al., 2007). Photographs of familiar items and situations provided the stimulus materials. These were selected to elicit both the sounds of the core phonology (Laycock, 1985; Romaine, 1992), those new phones recorded in the literature as in use (G. Smith, 2002) and any other phonemes heard locally.

Words for Book 1 were initially selected from a combination of Mihalic's Jacaranda dictionary (1989) and the Oxford TP dictionary (Volker, Jackson, Baing, & Deutrom, 2007), augmented by knowledge of local spoken usage. The target words and photographs chosen and trialled, and the range of responses given, are outlined in Appendix C. The adult participants would query the content of any photos not sourced locally.

Phonemes were targeted for elicitation in as many permissible syllabic positions as the current lexicon allowed. Positions included were Syllable Initial Word Initial (SIWI), Syllable Initial Within Word (SIWW), Syllable Final Within Word (SFWW) and Syllable Final Word Final (SFWF). Not all phonemes were expected in all positions according to the phonotactic restrictions of Tok Pisin (Table 5). For example, voiced plosives, fricatives other than [s] and affricates do not occur in coda positions in TP. However,

because of word borrowing and code-shifting associated with the creolisation process, these were sometimes targeted to check local usage.

4.3.2.3 Procedure. The verbal agreement of participants, after being verbally invited to participate, was the sign of their consent. Once informed verbal consent was obtained, demographic data was collected. Participants were then instructed as to the role of the picture book and the Olympus LS-12 voice recorder. The researcher instructed participants to name the pictures they were shown in Tok Pisin. It was explained that a recording of their voice would made, and would be stored for analysis. Participants were encouraged to ask any questions they may have, which were answered at this point.

The picture book was presented and if the target word was not produced, the researcher questioned the participant further in order in order to elicit the target. Given the pilot nature of this phase of the research, new photos and word targets were trialled when either photos or words, or a particular match, failed to elicit a target spontaneously. Some pictures elicited alternate words, and these were noted for trial in subsequent presentations (Appendix C). If the additional photos were not effective in eliciting target words for subsequent participants, they were removed.

Responses were transcribed during administration, with a broad transcription using the International Phonetic Alphabet (IPA). The session was recorded using the Olympus voice recorder. The researcher listened to the recording later in order to confirm transcription. Spontaneous comments were also recorded and transcribed.

Prior to further analysis, the researcher undertook intensive training in phonetics with Summer Institute of Linguistics Australia, including specific work in the Melpa substrate language utilising phonological data (Ladefoged, 2001, Stucky, 1990). Melpa studies utilised recordings (Ladefoged, 2012) and phonetic receptive and expressive drills with experienced field linguists. A narrower transcription of connected speech was then prepared from the original recordings with the assistance of the native speaker. When the transcription of the researcher and assistant did not match, the selection was listened to together and discussed until a consensus was found. This narrower transcription was subsequently entered for processing using *Phonology Assistant* (PA) software (SIL, 2015). This transcription added any connected speech elicited, providing additional phonetic data to the single word data previously prepared.

4.3.3 Analysis. There were two steps in the analysis of the adult phonetic data. The first step was to produce phonetic inventories for each of the individual participants and a phonetic inventory for the entire corpus. The distribution of matched sounds elicited in each syllabic position, which matched the phonetic spelling of the TP word, revealed the phonotactic distribution in this population sample (Table 8). Phones outside the TP inventory recorded in the literature were also noted. Participants' comments, illustrating their metalinguistic awareness of phonetic variants, were noted.

The second step was analysis of the data set which included all the participants' utterances in a narrower transcription, which was analysed using the SIL software Phonology Assistant (PA) (SIL, 2015). This allowed

several analyses such as minimal and similar pairs and phoneme segment occurrences in particular contexts. Phonetic consonant and vowel inventories were generated for each participant and the entire group. These were then compared to the phonetic inventories produced by the single word dataset and analyses.

Independent analyses of participant's phonological inventories were conducted utilising PA and following phonological principles (Burquest, 2006). Phonemic contrast in likely pairs and groups of phones was assessed. The following phonemic contrasts were the focus of this analysis: contrastive use of /f/ and /p/ and /w/ and /v/, voicing in final plosives, and contrastive use of /h/. In addition these phonotactic features were examined: use of consonant clusters and affricates use or continuation of the TP pattern of /s/ substitution. Expansion of fricative repertoires and distribution were also analysed. The phonemic status and distribution of phonemes outside TP core phonology; fricatives /z, ʃ, θ, ð, ʒ/ and voiced affricate /ʤ/ and unvoiced affricate /tʃ/, plus the flap /ɾ/ and lateral fricative /ɬ/, which are influenced by the Melpa substrate, were examined. The phonemic status of each of these, and their distribution in individual phonologies, was examined.

Contrast seen in each phoneme pair was examined for to assess whether they were in complementary distribution or free variation (Burquest, 2006). Minimal pairs are frequently used to establish phonological contrast. As a contact language, TP has a high level of redundancy. This means minimal pairs are not frequent, because they

involve single phonetic differences between words, which are rare in many contact languages (Plag, 1993). The minimal pairs which do exist are not found in this sample of data and, even if they were, are unlikely to be easily elicited or culturally appropriate for elicitation. Therefore, the similar pairs category, which were generated by the PA analysis (SIL, 2015), was often used to establish contrast. When free variation was found it was regarded as evidence that phonemic contrast was not established. For example, participant one used both /wos/ and /wotʃ/ as forms for the word ‘watch'. A summary of the results from analyses performed, using each participant's transcription in the PA software, can be found in Appendix D.

Syllable shapes were examined with a focus on consonant cluster use in onset and coda positions. Consonant cluster reduction in TP can be either by elision of one segment, which is usual in final clusters (Mihalic, 1989), or by insertion of an epenthetic vowel, which is more common in onset clusters.

In this way a local phonology for the consonants of this population was derived from the statistical data found in individual phonologies. Contrastive analyses were conducted of the complete transcription of all utterances of single word and connected speech.

4.3.4. Results. Results from the single word analysis are presented first, followed by phonological analyses and distribution features.

4.3.4.1 Consonant phonetic inventories. Table 8 displays the frequency of spontaneously produced consonant sounds targeted by Book one, in single words, across all syllabic positions. Consonants elicited in

more than 50% of opportunities were included in the phonetic inventory, a criterion chosen to accommodate the greater variation than in an established language phonology (Carrera-Sabaté, 2014; Lacoste, 2012; Ng, 2015). Percentage elicitation rates are included for each phoneme as an indication of the strength of each phoneme in this highly variable phonology. The occasional addition of English consonants which were elicited in less than 50% of opportunities are shown in brackets.

The phonetic inventory revealed use of some phones that are not present in Mihalic's list of sounds (Mihalic, 1989, pp. 4-8). These included [z/] [ʃ/] and the voiceless affricate [ʧ]. New distribution was seen of /v/ in SFWF position, and the voiced affricate /ʤ/ added positions other than SIWI. All these occurrences were analysed phonologically in the subsequent step of analysis. A similar range of sounds was recorded in the connected speech and single word samples.

Table 8. Distribution of Phonetic Repertoire, Adults. Derived from Boer and Williams (2017).

Manner	**% SIWI**	**% SIWW**	**% SFWW**	**% SFWF**
Plosive	/p/78	/p/95 /b/79	/p/ 62	/p/ 63
	/b/ 92	/t/86,		/t/69
	/t/85 /	/d/ 63,		
	d/100	/k/87,		/d/85
	/k/87	/g/ 31	/k/ 92	/k/ 83
	/g/81			/g/ 31
Nasal	/m/ 94	/m/ 90	/m/ 69	/m/ 92
	/n/ 64	/n/ 100	/n/ 85	/n/ 90
			/ŋ/ 60	/ŋ/ 75
Affricate	/ʧ/ 23	/ʧ/ 42		/ʧ/ 33

	/ʤ/ 69	/ʤ/ 65		/ʤ/ 54
Fricative	/f/82	/f/ 92		/f/ 77
	(v) 31	/v/100	/v/ 31	/v/ 31
	/s/73, (z)23	/s/ 80 (z) 23	/s/ 88	/s/ 66 /z/ 18
	/ʃ/ 19 /ʒ/ 31	/ʃ/ 38		/ʃ/ 31
	/h/ 17			
Lateral	/l/100	/l/89	/l/ 38	/l/79
Flap or trill	/ɾ/95	/ɾ/90	/r/ 92	/r/85
Glide/	/w/67	/w/82		
Approximant	/j/85			

4.3.4.2 Phonological analysis results. The results of the single word analysis were augmented by contrastive analysis. Collated summaries according to manner groups are outlined in Table 9. Further details for individual participants are provided in Appendices C and D.

Table 9. Summary: Adult Phonological Use

Phoneme by manner	**Observed use.**	**%age Sample using contrastively**	**Example**
Plosive			
SFWF /d, g/	100%	58% with unvoiced	/dog/ not /dok/ 'dog'
Fricative			
SIWI, SIWW /f/	100%	60% overall with/p/ 83% SIWI	/fɪs/ not /pɪs/ 'fish' /lif/ 'leaf' not /lip/ /fama/ 'farmer' loanword
SIWI, SIWW /v/	75%	25% with /b/ 58% with /w/	/viles/ 'village' /draiva/ 'driver
SFWF /s/	100%	50% with affricate	/fruts/ 'fruits'

SFWF /z/	58%	25% contrast with /s/	/brɪz/ 'bridge
SIWI, SFWF /ʃ/	92%	25% contrast with s/	/fiʃ/ 'fish' /maʃɪn/ 'machine'
SIWI /θ/	42%	No pairs	/θripla/ 'three'
SIWI, SIWW /h/	100%	17%	/haus/ 'house'
Affricate			
SIWI, SIWW, SFWF /ʧ/	92%	25% with /s/ 25% with /ʃ/	/tiʧ/ 'teach', /tiʧa/ /ʧekim/ 'to check'
SIWI, SIWW, SFWF /ʤ/	100%	50% with /s/	/ʤizas/ 'Jesus' /brɪʤ/ 'bridge'

Note: Percentages are the percentages matching the opportunities for each phone.

Features of interest were the presence of affricates in SFWF position for every participant, albeit most often in English loanwords. Loanwords were defined as those that were not in either Mihalic's TP dictionary (Mihalic, 1989) or in the more recent Oxford dictionary of TP (Volker et al., 2007). Fifty percent used the affricates contrastively in similar pairs identified by Phonology Assistant for SFWF position. Both individual and group data and phonological data shows an emerging phonological contrast in multiple syllabic contexts distinguishing /f/ and /p/ for the majority of speakers in this sample.

The new phonological inventory (Table 10), for use with the child study, was derived from both the adult single word data on the frequency of elicitations (Table 8) and the contrastive analyses which are summarised in Table 9. Table 10 displays the consonant phonology inventory obtained from analyses of both the single words and complete utterances. The

phoneme /h/, although not used contrastively, is part of TP orthography (Smith & Siegel, 2013b). Phones in brackets, indicating less than 50% occurrence, were found mainly in loanwords.

Table 10. New Phonological Inventory (Boer & Williams, 2017)

	Bilabial	Labio-Dental	Alveolar	Post Alveolar	Palatal	Velar	Glottal
Stop	p, b		t, d			k, g	
Nasal	m		n			ŋ	
Affricate			(ʧ)	ʤ			
Fricative		f, v	(ʃ)				(h)
Trill			r				
Lateral			l				
approximant	w				j		

Note: Occurrence in > 50% of participants (<50% bracketed)

4.3.4.3 Phonological distribution in this population. The distribution of phonemes showed some emerging differences from those described in the literature (Table 4) (Smith & Siegel, 2013b). Table 11 shows a syllabic distribution analysis of the percentage of target sounds successfully elicited. These are based on targeted sounds elicited in single words as a percentage of all responses, rounded to whole numbers. Phones which occurred with percentages less than 50%, were included in the chart but shown bracketed, indicating that this phoneme distribution was seen, but below this targeted level of significance.

Changes noted from the phonology described in the literature (Table 2), which is detailed in chapter three, are as follows: Voiced plosives are here appearing in final syllable positions, and a wider range of fricatives occur in word final positions. The contrastive use of the unvoiced labiodental fricative /f/ and medial voiced affricate /ʤ/ is also new. Other fricatives appear either in less significant percentages or are not contrastive.

Table 11. Distribution of Consonants by Syllabic Position.

Position	Phonemes
SIWI	p, b, t, d, k, g,
	m, n
	f, (v 38%), s, (z 23%), (ʃ 25%, ʒ 31%, h 22% ʧ 23%)
	w, l, r, j
SIWW	p, b, t, d, k, (g 31%)
	m, n
	f, v, s, (z 23%, ʃ 38%, ʧ 42%) ʤ
	w, l, r
SFWW	p, t, k
	m, n, ŋ
	(v 31%), s
	r
SFWF	p, t, d, k, (g 31%)
	m, n, ŋ
	f, (v 31%), s, (z 18%), (ʃ31%), (ʧ 33%) ʤ
	l, r

Note 1: Legend: SIWI: syllable initial word initial, SIWW: syllable initial within word, SFWW: syllable final within word, SFWF: syllable final word final.
Note 2: Occurrence in > 50% of participants, (<50% bracketed)

Some phones; namely /p, k, m, n, s, r, l/, were noted in all syllabic positions. SFWW consonants were less common than other syllabic positions (9/14 phonemes). Some phones were restricted to SIWI or SIWW positions. For example; /w/, /b/ and /h/ were found just in SIWI and /v/ was not frequent unless in SIWW position, as in /draiva/. The SFWF position contained some phones less frequently; /d, f, ʤ/ or, as with /ŋ/, were restricted to SFWW or SFWF.

4.3.4.4 Phonotactic structures. Initial and final consonant clusters recorded are sampled in Table 12. Words which were regarded as recent borrowings, or localised to the Highlands region only, are those not found in either of the TP dictionaries (Mihalic, 1989; Volker et al., 2007).

The adults of this pilot study population show a comprehensive range of phonotactic structures, with many of the phonotactic restrictions of pidgin languages, seen in TP, beginning to give way to more complex distribution patterns. The most common syllable shape in TP and in this sample are CV and CVC, leading to word-shapes like CVCVC. The preference for CVC structure does not preclude vowel onsets such as the pronoun /em/, 'he, she, it' or /olsem/, 'like, in the manner of'. Reduplication is a common feature of TP and was seen often in word use in this adult population in words like 'saksak' (starchy plant), ‘waswas’ (swim) and 'matmat' (grave).

Table 12. Initial and Final Clusters: Adults.

Syllable initial	**Example**	**Gloss**
pl	/ples/	place
bl	/blekpela/	black
br	/brɪs/or/brɪʤ/	bridge
dr	/mendrɪn/	mandarin*
fl	/flauwa/	flower
kl	/klaut/	clouds
gl	/aiglas/	glasses*
gr	/grɪnpot/	green pot (type of pineapple)
st	/stap/	verb 'to be'
sm	/smuk/	smoke
str	/stretɪm/	straighten, put right, organise
Syllable final	**Example**	**Gloss**
pl	/painapl/	pineapple
nt	/egplent/	eggplant*
ks	/boks/	box
ts	/juts/	youth
kst	/nekst/	next
st	/gest /	guest*
ls	/metrels/	materials*
ŋk	/sɪŋk/	sink
nʤ	/orɪnʤ/	orange

*Note: *Indicates recent borrowings.*

Variation is extreme at both segment and syllable level. Examples of the range of complexity of syllable and word structure can be seen in Table 13.

Consonant clusters were still sometimes removed by the insertion of epenthetic vowels, but intact clusters were evident in English borrowings such as the TP for: /simuk/, 'smoke', being replaced by the English form /smouk/ or /smuk/. Less commonly, final consonant blends were present in borrowed forms such as /ailans/, 'Highlands', /froduks/ ' products, /frant/ 'front, /klaudz/ 'clouds'.

Table 13. Syllable Structures Sampled.

Syllables	Phonotactic structure	Sample word	Gloss
1	CV	/mi/	me
	VC	/ol/	all
	CVC	/han/, /fɪʃ/	hand, fish
	CCVC	/plet/	plate
	CCVC	/braid/, /smuk/	bride, smoke
	CCVCC	/klaudz/	clouds
	CVCC	/lains/	group
	CCVCC	/frant/	front
2	CVCV	/pato/	duck
	VCVC	/olɪm/	'to hold'
	CVCVC	/sɪmuk/, /kukɪm/	smoke, to cook
	VCVCC	/orɪmz/	orange
	VCVCCC	/orɪmdz/	orange
	CCVCCV	/θrɪpla/	three
	CVCCCV	/bɪkpla/	large
	CCVCVCC	/frodaks/	products
	CCVCVC	/draivɪm/	to drive
	CCCVCVC	/stretɪm/	to fix, straighten
3	CVCVCVC	/senɪsɪm/	to change
	CVCCVCV	/faivpela/	five
	CCCVCVCVC	/stroberɪs/	strawberries
4	CVCVCVCV	/pɪkɪmɪ/	child
	CVCVCVCVC	/sɪkarapɪm/	to scrape (a coconut)

4.3.5 Discussion

4.3.5.1 Phonetic inventory. A similar range of sounds was recorded in the connected speech and single word samples which was an endorsement of a single word elicitation task in this project. The phonetic inventories in the local dialect of these adults reflect their exposure to the phonologies of English and the substrate Melpa, in addition to TP. In general, they are faithful to TP phonology when speaking TP, especially if they are monitoring themselves. Codeswitches were often self-corrected from creole forms to classic TP**.**

4.3.5.2 Impact of loanwords on phonological expansion. Some words which were needed to express new concepts, brought new phonological segments and distribution with them. Examples are /sowɪŋ masɪn/, 'sewing machine', /stroberis/, 'strawberries' and /egplant/, eggplant'. Examples of segment introduction were the introduction of the unvoiced affricate in adopted words like /tɪʧa/. Sometimes anglicised pronunciations such as /kloudz/ 'clouds' rather than TP /klout/ were adopted. Adoption of English forms of counting such as /θɾi/ 'three', introduced both new complex onset clusters and the dental fricative. The latter was infrequent but the TP 'tripela' is now heard infrequently and tri' is a valid alternate (Volker et al., 2007). When the adult phonological model includes English count nouns, these are regularly used templates that have the potential to change phonological use (Vihman, 2016).

Variation was a constant in this creolising language. The adults were often very aware of their variation, sometimes listing different forms of the same target word. Research in other multilingual populations has shown that socially mobile speakers' metalinguistic awareness reflects their desire to use phonological forms to gain social mobility (Carrera-Sabaté, 2014). A targeted research project would be required to determine the degree to which a phoneme was an integrated borrowing and was a complex task beyond the scope of this study. Such a process would require both synchronic and diachronic analysis.

4.3.5.3 Phonemic changes. Thus both group and individual analyses, in both the connected speech and single word data sampled, show a phonology wider than that described in the literature (Mihalic, 1989; Romaine, 1992; Smith & Siegel, 2013b). Some new phones occurred with insufficient frequency to be included in the phonology. An example is the lateral fricative /ɬ/, which may indicate substrate influence (Ladefoged, 2001). The limited contrastive use of /tʃ/ and the innovation of SFWF /dʒ/ do not justify their being included in the phonology. The occurrence of post alveolar fricatives /ʃ/ and /ʒ/, the unvoiced more frequently, with some participants using /s/ and /ʃ/ contrastively warrants monitoring /ʃ/ in the child developmental study. Although /ʃ/ and /ʧ/ were not uniformly used, they were frequent enough to be included in a the child study to clarify their status.

A finding of most significance in the adult pilot study was that of the contrastive use of /p/ versus /f/ in this population. Romaine's comment that 'from a markedness perspective, fricatives are more marked than stops' (1992, p. 180) suggests this is a development moving away from universal patterns. The classic TP pattern which realises the voiceless labiodental fricative /f/ as a voiceless bilabial plosive /p/, follows a universal pattern. This is changing where TP is creolising, and this pilot study shows that /f/ is now appearing in this Highlands population. Examples are words like /fis/; replacing TP /pɪs/ for 'fish'. Our connected speech samples were examined for contrastive use of the phones /f/ and /p/ rather than free variation. Free variation would indicate allophonic rather than phonemic status. The results from both the group data and the individual phonologies suggests that a contrastive distinction is emerging between [f] and [p] in this population sample. This contrast was found in all phonetic contexts for 66% of speakers and 83% in syllable onsets. It appears that an ability to perceive and use /f/ and /p/ contrastively is becoming part of typical phonological acquisition in this population. This contrast from English phonology is a feature of ongoing creolisation. This is a change in the phonology of Tok Pisin from that reported in the literature which describes /p/ dominance in Highland speakers, which is also the status most recently in the APiCS entry (Smith & Siegel, 2013). Further detail of individual participants' contrastive use of /f/ and/p/ can be found in Appendix D.

The changes in fricative use and fricative/affricate contrast in this population are also of interest. The phoneme /dʒ/, formerly restricted to the

SIWI syllabic position is occurring SIWW, in contrast to the phonotactic constraint Mihalic noted (1989). This is a change which Smith also observed (Smith, 2002, p. 49). The strength of unvoiced fricative /s/ over affricates and voiced fricatives is an indication of universal pressure. However, the strength of the affricate /ʤ/ in this population is not universally typical and its use in our sample may reflect the influence of a substrate. It is interesting that Highlands TP speakers choose the voiced affricate /ʤ/ to realise the voiced alveolar fricative [z] in borrowed words like 'zipper' [ʤɪpa] with one exception who used [z].

***4.3.5.4 Phonotactics and Phonological universals*.** There is a suggestion in the wider literature that creoles show universal patterns in their phonotactic or distribution rules. Historical TP shows the general pidgin tendencies to a smaller inventory of sounds, a restricted syllable structure with a preference for open syllables, a tendency to reduplication (Mühlhäusler et al., 2003) and unmarked simple syllabic and word structures (Kinney, 2005). Mastery of a range of complex syllable structures seen in this adult population (Table 13) is beginning to show a departure from the simplicity of a pidgin language.

This adult population were typical of a creolising language in terms of their variation of phonotactic as well as phonetic usage as they adopt other forms. New forms include the phonotactics seen both in the phonologies of the superstrate; English, and the substrate language; Melpa. Both have complex onsets and codas in comparison to TP (Ruby, 1990). Structural

syllable and word shape changes are evident in the sample with both the adoption of new words and morphophonemic condensation as a function of creolisation (Romaine, 1992).

Examples of SIWI consonant clusters in the PA analysis were seen in morphophonemic contractions such as /bloŋ/, and recent loanwords such as /flauwa/, not found even in the Oxford Tok Pisin- English dictionary (Volker et al., 2007). These uses may be instances of creole bilingual speakers code-mixing and of them having English phonology at their disposal as well as TP (Smith, 2002), and at times incorporating this into TP words. An example is the initial fricative-plosive-r cluster in /stretım/ ‘straighten/fix’ which was produced by three participants.

4.3.6 Adult input to lexical content of naming task. Adult participants' comments led to the removal of several words and pictures in Book 1. These included words discovered to be anachronistic like /dıdıman/ 'farmer' which has been replaced by /fama/ for spoken use in Mt Hagen area, even though it still features in signage around Mt Hagen.

4.3.7 Conclusions: Adult Pilot. The variability of Tok Pisin makes it difficult, and perhaps unwise, to establish a definitive description of the phonology, but this pilot study gives valuable insight into this local Highlands variation. Code-switching was seen in these adults, which indicates input from more than one phonology (Docherty & Khattab, 2008). However, the concept of variation around a core phonology is one way of reflecting flexibly on the phonology (Wakizaka, 2008) in order to have some

guidelines for a clinical phonology. This adult pilot study allowed a clear picture of the local core phonology and emerging changes that require monitoring during the child cross-sectional study. These findings provide a model against which it is possible to evaluate phonological development in Tok Pisin-speaking children in urban and semi-urban populations of the Western Highlands Province.

4.4 Child Pilot Study

Once the adult pilot study had clarified the phonology described in the literature according to local usage, the next step was to create a naming task appropriate for use with children. Two primary steps of design are conceptualisation and operationalisation, or implementation (McLeod, 2012). The child pilot study implemented the concept as it tested and adjusted content and presentation protocols through field-checking of the sampling tool.

4.4.1 Purpose: Implementation of child pilot. The child pilot had several steps leading to the preparation of Book 3 for the child phonology study (Figure 1). Each step sought to improve the efficiency, construct and content of the tool.

The field testing, which had begun with insights from the adult pilot study, was completed with the child pilot study which trialled two subsequent picture books. The procedures of the child pilot study field-testing will be outlined in the next sections. Initial field testing of Book 1

was conducted with eight children. This added to the insights from the adult pilot and led to extensive revisions to both target word and picture content. Book 2 was then produced and field- tested with nine child participants between the ages of three and six years. The field-testing of Book 2 showed that further revision was required, and Book 3 was then produced.

4.4.2 Method. The procedures involved in word and picture selection and revision with field-testing for both Book 1 and Book 2 are outlined below.

4.4.2.1 Participants Child Pilot. A convenience sample of 20 children, aged between three and eleven years, was sourced from local pre-schools, communities and acquaintances for field-testing of the three books (Table 14).

Participants in the pilot studies were mainly limited to one substrate vernacular language group, Melpa, the dominant vernacular language of the Mt Hagen area. This constraint was imposed to reduce the complexities of substrate language colouring of the phonology of TP.

Written consent was obtained from each child's parents. Children expressed their consent by circling a 'happy face' icon rather than a 'sad face' icon (Appendix L).

Table 14. Child pilot study participants.

Participant number	Age	Gender	Book number
1	approx. 5	F	1
2	3	F	1
3	3	F	1
4	6	M	1
5	9	M	1
6	6	F	1
7	6	F	2
8	n. d[i]	F	1
9	3-4	M	1
10	11	M	1
11	3	F	2
12	5	F	2
13	6	M	2
14	n.d.[i]	M	2
15	5	M	2
16	5	F	2
17	4	F	1
18	3	M	3
19	4	M	3
20	3	M	3

Note: [i] No date of Birth

4.4.2.2 Procedure: Task administration. Children were seen in local, familiar contexts, often with family members present. One child was seen in the hospital clinic with her mother. For early participants, presentation was

by the researcher alone, but recruitment of a native speaker assistant led to her replacing the researcher as the presenter. Encouragement, direction and sometimes modelling were provided in line with culturally determined approaches to learning.

Although children are notionally tagged to a version of the stimulus book, this did not mean that they were all exposed to the same content for each book. The book development was an iterative process. When stimulus pictures or target words did not lead to ready elicitation, replacement pictures and words were added and field-tested with the subsequent participants. Book 1 was structured with single word naming only, Book 2 trialled some supplementary pictures designed to elicit connected speech. Book 3 consisted of single word naming and some picture sequences designed to elicit words in connected speech.

4.4.2.3. Procedure: word selection and revision. Although nouns are easiest to stimulate, some familiar verbs and adjectives were also included to elicit the complete range of phonemes. The tool aimed to cover a variety of word shapes with some multisyllabic words but a majority of monosyllabic and bisyllabic words.

Children's smaller vocabularies made revisions of the word content necessary after the first trials of Book 1 with children rather than adults. Initially new words and photographs were added, then both were revised completely for Book 2. It became apparent that words could fail to be elicited for several reasons. They may have been anachronistic or not appropriate to local Highlanders' use. Many of these words were identified

by the adults and this input, combined with the child field-work on Book 1, led to significant revisions of the word targets in Book 1. Some words, such as /sıza/,'scissors', in the adult vocabulary, were not yet present in the vocabularies of younger children. Children sometimes did not yet have the life experience to interpret some pictures, such as the 'bung' or gathering of a community court, as well as adults. Of the 167 target words in Book 1, just 39 were retained, with lexical and phonetic duplicates eliminated and additional alternate words being trialled in Book 2. Alternate target words for the phonological targets were furnished with appropriate photographic stimuli. These new elements were then included or discarded. Words kept and discarded are found in Appendix F and the word list for book 2 is outlined in Appendix G. At each step, decisions about suitability occurred in conjunction with field-testing.

Because all the target words were not spontaneously produced, Book 3 included an additional task of sequence stories. The content of these stories was chosen both for its familiarity to children in this population and the phonetic content of the words that were likely to be spontaneously elicited by this task.

Before the printing of each successive picture book, the content was analysed according to how many opportunities there were for each phoneme to be realised in each phonotactically appropriate syllabic position. Words with multiple phonetic targets were sought, in order to keep the tool as concise as possible. The summary of the opportunities for each phoneme

target finally available in Book 3, may be found in Appendix G, Table G2. Book 3 was the culmination of the field-testing process and was also field tested on four participants prior to use in the larger child study. Although the photographic content remained unchanged throughout with Book 3, even during the child study, the word targets were modified as younger children's word use and picture recognition became clearer. An identical group of target words were analysed finally for all participants.

4.4.2.4 Picture selection and revision. Locally sourced photos were most successful, but not all local photographs elicited what was expected, so alternate photographs were sourced and trialled throughout the process. For example, a /patou/ 'duck' picture, despite being sourced locally was unfamiliar to most children and was removed. The researcher frequently brain-stormed what type of photo would elicit a target word, and appropriate scenarios in which to source it, with the research assistant and other local friends. Photographs were taken locally with people and settings children recognised, as this type of photograph most successfully led to spontaneous word elicitations. Examples of the photographic material used may be found in Appendix H. Confirming picture recognition patterns through child pilot study field work was essential.

4.4.2.4.1 Book 1 picture revisions. Field testing of Book 1 led to discarding of some photographs, for several reasons. The first was any photographs that didn't resonate culturally immediately with the children, such as the white family group, which was replaced with a picture of a

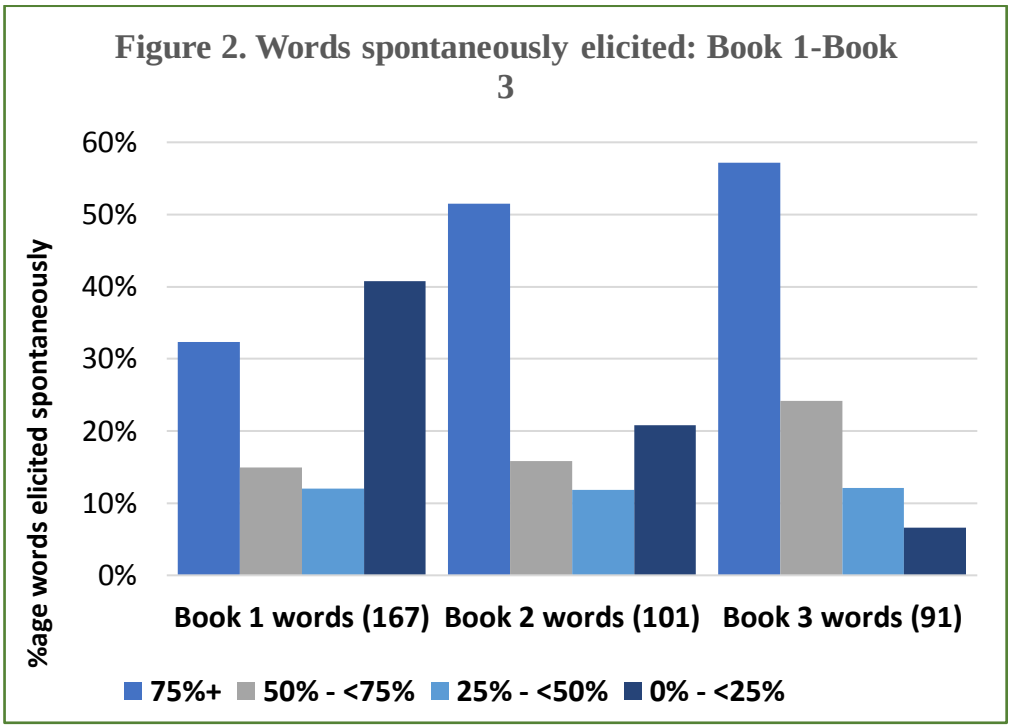
Papua New Guinean family. Other photographs were discarded because the focus wasn't clear enough, a photograph of a girl standing under a waterfall produced too many results, or none. Extensive revisions were made to the photographs and target words of Book 1 with most pictures being either discarded or re-purposed for a different target word.

4.4.2.4.2 Revisions of pictures book 2. Supplementary photographs were included in Book 2, as a method of probing which pictures would resonate best with the children to elicit target phonemes words and phonemes. Some of these, such as /tebol/ 'table' were found to be effective and subsequently included in Book 3. Just six pictures needed to be removed in the revision of Book 2, two only for conciseness, and several had the target word changed. There were however some surprises, for example a picture of PNG children in school uniform playing in a school playground proved to be too ideal to elicit 'skul pikinini'.

The level of spontaneous elicitation of target words was a product of both word and picture choices. The process of refinement was illustrated with the following analysis. Words in each book were scored according to the spontaneity of their elicitation. Each book was subsequently analysed as to the percentage of words which were spontaneously elicited, and four quartile categories created to reflect these frequencies. For each book, words were allocated to quartiles. If for example, the word was elicited 75 % or more of the time, it was allocated to the top quartile, and so on, for all the words (Figure 2).

Thus, with each successive book the goal was to further improve the picture content and target words in terms of the tool's ability to spontaneously elicit the target words and with them, the range of phonetic content.

4.4.3 Results. Figure 2 shows a progressive compilation of results for books one to three and demonstrates better spontaneous word elicitation for each new book. The pictures in Book 2 designed to elicit connected speech did not generate results that were consistent enough to be used, so this approach was discarded. The exception was the picture of a dog and girl watching a man scraping coconut. Because it consistently elicited the phrases "man sikarapim kokonas, wait meri na dok" (a man is scraping coconut, a white woman, and a dog) the target words were retained for Book 3. The story sequences in Book 3 only elicited two words reliably, so these two words from the story sequences were retained.



There is an increase in the top quartile of elicitation rate from 32% in Book 1 to 51% in Book 2 and 57% in Book 3. Words belonging to the lowest quartile were 41% of Book 1 but dropped to 21% in Book 2, then 7% in Book 3, indicating a significant reduction in the number of words not elicited.

Each successive book was more successful at eliciting the target words and therefore the target phonology, and fewer words were required as the elicitation became more economical (Table 15). There were 167 words in Book 1 and 101 words in Book 2. Book 1 was often too long for young children. Word changes were not universally successful. Changes made to Book 1 to produce Book 2 did not work for every child to whom Book 2 was presented and were further revised to produce Book 3.

Table 15. Improvements Between Books.

	Book 1	Book 2	Book3
Number of stimulus pictures	62	46	35
Number of target words	167	101	67
Successful words, i.e. %age children who produced target word spontaneously 75% or more of pictorial presentations	32	51	
Failed words: i.e. %age of children who produced target words spontaneously only 0-25% of presentations	41	21	

4.4.4 Discussion

4.4.4.1 Age impacts on elicitation rates. As expected, age was a factor in successful elicitation of words. This was apparent from the Book 1 results which had spontaneous elicitations of 31% for three-year-olds, 43% for 6-year-olds and 54% for 10-year-olds. Unelicited words decreased and spontaneous elicitations increased.

4.4.4.2 Word refinement. There were local usages that meant words had to be re-defined and elicited differently, or discarded (Table 16). Sometimes children would give a Melpa name to the photographic stimuli. When this occurred, we needed to reflect the local language use both in word targets and their phonological content. A semantic example is that /waswas/ for 'swim' could not be elicited from these children who lived near steep mountain creeks, but /daiv/, 'dive' was readily elicited. Some words could be elicited in a different context, for example ‘singsing’, which was

required to elicit /ŋ/, was more successfully elicited as a verb in a church setting than a noun in traditional setting. Traditional dancing and singing tended to elicit the Melpa words used on these occasions: /weldo/ and /waipe/. Book1 and Book 2 sought to give maximum opportunities for the adults and children to demonstrate their habitual vocabularies and pronunciation. Attention to lexical non-phonetic factors led to a better rate of spontaneous elicitation, or stimulability, overall between Books 1 and 2. Table 16 illustrates some of the reasons for word discards, more detail of the process is given in Appendix F.

The iterative nature of the refinement is seen in that after the Book 1 trials, 47 words were discarded, 12 changed and 19 picture changes occurred. For Book 2 there were 25 additional target words trialled and 20 new pictures trialled. After Book 2, 20 words were discarded, four changed, and six pictures discarded. Samples of discards and the reasons the target words were not produced can be found in Table 16.

Table 16. Illustration of Word Discards

Target word	Gloss	Word elicited	Reason for discard
/sumatin/	student	/skul mangi/	Local usage
/nambis/	coast	/waisan/	Child lifestyle experience: children have only seen gravelly river sand
/baret/	drain	/rot/ (road or track)	Child lifestyle: the 'baret' or drain is their road around the community
/bɪnantang/	insect	/lapun meri/	Dictionary use re-defined locally, tended to name the specific bug.
/simuk/	smoke	/kukim ston/ (heating stones) or /man souths/ (Southern Highlands men) or /ol lain sindaun/ (they are all sitting down).	Distraction by other features of the picture. Could not be elicited with alternate pictures of either a mumu fire or men smoking
/bilas/	decoration	Area names: e.g. Jiwaka, Hagen	Different priorities and focus. Dressed-up singers elicited statement of which tribe's costume it was, tribal affiliation was paramount.

4.4.4.3 Consonant target frequencies by syllabic positions. The final target words selected allowed for examination of phonemes in phonotactically permissible syllabic positions. The frequency of target phonemes by syllable positions is shown in Appendix G, Table G2. Six phones were sampled in three syllabic positions (30%), eight phones were sampled in two syllabic positions (40%) and two phones were measured in one syllabic position each. The sounds monitored in one syllabic position were being monitored for emerging use in TP. They were /z/ and /ʧ/. In

addition, the post alveolar fricative /ʃ/ had no specific target but was monitored as it occurred as a variant form in the target words for three syllabic positions, SIWI, SIWW and SFWF.

4.4.5 Conclusions. Attention to sociolinguistic factors at each book revision allowed improved rates of spontaneous elicitation with fewer pictures and target words and therefore a shorter administration time. These led to a more effective tool in Book 3 for use with the child phonological study. Further changes were made as a result of the administration of Book 3 during the research. Prior to analysis eight words were removed, and 67 words were finally analysed for all measures (Appendix G, Table G2).

The method and results of the cross-sectional child study are outlined in the next two chapters.

Chapter 5. Method

5.1 Design and Purpose

The study was a cross-sectional observational study of the development of TP speaking children's phonology between age three and seven years old. The purpose of the study was to provide preliminary phonological data for clinical purposes in the Highlands of Papua New Guinea. It was hypothesised that age would have an impact on the phonetic and phonological inventories and that the sequence of phoneme acquisition and developmental processes would reflect universal patterns. It was further hypothesised that gender would impact phonological acquisition. The research questions were addressed using both independent and relational measures (Baker, 2004; Dyson, 1988).

5.2 Ethics

Ethical approval was obtained through Curtin University Human Research Ethics Committee (HREC) prior to the commencement of the pilot studies. Approval number RDHS-85-15. In addition to HREC approval, a police clearance certificate was sought in May 2015 from the PNG Royal Constabulary and obtained for the duration of the data collection period. Elders of the Melpa community and a native speaker assistant acted as cultural and language consultants.

5.3 Procedure

The culturally appropriate community liaison and consent-gathering approaches used have been described in chapter four. Following initial contact with the community leaders, meetings were arranged and held to inform the community, collect consents and complete questionnaires. At this meeting the

researcher spoke about the project and distributed the information sheet which was provided in English and Tok Pisin (Appendix I). At this time, consent forms were also provided to all families attending the gathering. This was often preceded by speeches from community leaders and followed by responsive speeches from men in the community, as is common PNG practice (Connolly & Anderson, 1983). Following the presentation, the research team, consisting of the researcher and assistant, were available to answer questions and assist with completion of consent forms. At this time, demographic information and information regarding language use in the home was collected using a newly devised questionnaire (Appendices J and K), as no language use questionnaires focusing on inputs and outputs for multilingual children have been published previously. Language use data was recorded both to ensure that children fitted the inclusion criteria and to further understand language use patterns. A separate visit from the research team was arranged if required, to allow families more time. Sometimes families required further support in completing the consent form and demographic information questionnaires. The forms, the answers and the explanation of the research process were discussed in either TP or Melpa. Additional participants were recruited during follow-up visits to smaller groups of mothers.

5.4 Participants

For this preliminary study, an age-stratified convenience sample of 80 participants was sought to complete four twelve- month age groups (3;0-3;11, 4;0-4;11, 5;0-5;11, 6;0-6;11) of twenty participants each. The two gender groups were Females (38) and males (42). Chase and Johnston (2013) suggest that valuable data can be obtained by small samples of up to twenty subjects

(2013). A G*Power (Version 3.1.9.2) (Faul, Erdfelder, Lang, & Buchner, 2007) A priori calculation was conducted using a power of 0.95 and significance of 0.05, in order to find a large effect size of $f = 0.5$. This indicated a sample size of 76 was required.

Participant data collected included age in months, site of data collection, family language use and parental education and occupation data from parental questionnaires. On the day of data collection, Upper Respiratory Tract infections (URTI) were noted. Data from the questionnaires was analysed with the research assistant and each participant's family allocated to a category within a four point nominal scale for both language use and family education and occupation.

5.4.1 Participant characteristics

The distribution by age group and gender is shown in Table 17. Participants attended a range of schools within the greater Mt Hagen area, with the majority attending two pre-schools; Kalina and YC Rebiamul. The proportions of participants from each site showed that four of the eight sites contributed most of the participants: YC Rebiamul (30%), Kalina pre-school (26.3%), Kuri Community (21.3%) and Mt Kuiya Elementary and community (13.8%).

Table 17. Participant Distribution by Age-Group and Gender

		Gender		
		Female	**Male**	**Total**
3 year old group	Count	9	11	20
	% within age group	45.0%	55.0%	100.0%
4 year old group	Count	7	13	20
	% within age group	35.0%	65.0%	100.0%
5 year old group	Count	12	8	20
	% within age group	60.0%	40.0%	100.0%
6 year old group	Count	10	10	20
	% within age group	50.0%	50.0%	100.0%
Total	Count	38	42	80
	% within age group	47.5%	52.5%	100.0%

5.4.2 Inclusion criteria. Typical neurological and sensory function based on parent and teacher report was required. There is not yet any speech development screening tool supported by research available for PNG. We chose to include all children in this study in order to describe the typical range, unless their speech delay was judged extreme by the teacher, parent or the research assistant. TP was required to be the main, or one of the main languages of all participants. Participant's primary substrate influence was required to be Tokples Melpa, the regional vernacular. This was done to reduce the phonetic complexity of the children's backgrounds. Some participants, in addition to having Melpa as their primary vernacular, also were exposed to other vernaculars which were part of the extended family linguistic profile. The requirement was not exclusive because families can have second or third vernacular input, and this can change over time.

5.4.3 Parental occupation and education levels. The demographic questionnaire completed during consent-gathering provided information about parental occupation and education. Completion of the questionnaires was not compulsory and therefore not all questionnaires were fully completed. As most parents did complete the questionnaire, there was sufficient data to indicate the social characteristics of this population sample (Table18). The nominal scale created encompasses education level and occupation, ranging from rating one: tertiary educated professionals, rating two: secondary educated parent with business or skilled labour, rating three: primary or secondary education with farming or small business, to rating four: uneducated subsistence farmers (Appendix J).

Table 18. Parental Occupation and Education

Parent nominal category	3 YO group	4 YO group	5 YO group	6 YO group	Total
Tertiary educated parent, professional role	3	5	3	3	14
Secondary educated parent, business or skilled labour	4	2	5	6	17
Primary or secondary education, farming+ business	7	10	6	9	32
Primary or no education, subsistence farming	6	3	6	2	17

5.4.4 Family language use. Language use of written material, radio and TV in the home was further analysed from the questionnaires completed with parents. In consultation with the research assistant, the answers given in this

questionnaire were summarised to give a language-use descriptor for each family on a four point nominal scale which indicated the balance between English, TP and Melpa for each family. The four-point scale ranged from mainly English media and mixed TP and English conversation to TP and only little media. These categories were descriptive only but were designed to describe the balance of language use at the different sites and for individual families (Appendix J).

The distribution of language use and parental occupation by age groups are shown in Appendix K, and graphed in Figure K1 of that appendix. In this population, the family language use survey showed a variety of combinations of English, TP and Melpa, but each had a strong element of TP use. Thus, the inclusion criteria, that TP was a significant part of participants' language use, was met. It should also be noted that a number of families had more than one vernacular language in their family language use.

5.5 Data Collection

Data was collected between June 2015 and March 2018 in and around the Western Highlands Province (WHP) city of Mt Hagen in PNG. The sites providing participants and hosting data-collection included two private pre-schools, two government/church elementary schools and two community sites. The local research assistant assisted with data collection and processing.

Data collection took place in pre-school store-rooms, churches and outside in school play areas, as none of the sites had quiet withdrawal rooms. Sometimes it was necessary to utilise the researcher's vehicle in grassed areas outside the school because of sound levels. Once the project was underway, in two of the clan areas, local comments and behaviour indicated the researcher

was owned by the community. This facilitated some data collection in local homes, moka (gathering) areas (Strathern, 1973) and at the researcher's home when schools were closed.

For each participant, data was recorded at a single point in time. At the beginning of the session, the content of the child assent form (Appendix L) was read to each child and explained, either in their mother tongue or TP, by the local research assistant, prior to the child being invited to complete the form.

Care was taken to accustom the children to the naming task, as this is not a common task in PNG. The researcher participated in class activities where naming was modelled and incorporated into a story-telling activity with opportunities for the children to observe, practice and become more confident at naming pictures. The research assistant, who was known to the children and familiar with local culture and language, presented the picture book of local photographs to the child participants. Modelling supported the children when their vocabularies did not allow spontaneous elicitation of a word. Semantic clues were initially used when words were not spontaneously elicited. Cloze phrases trialled during the child pilot study were found to be ineffective. Spontaneous elicitation in the child study increased with age (for details see Appendix N). Modelling is thought to be a culturally acceptable practice not unknown to the children (Rumsey, 2014).The children's responses to the structured naming task were transcribed by the researcher in IPA at the time of collection and audio recordings were also made.

Younger children sometimes came to the withdrawal area in pairs, but data was collected separately. Each child was given time to settle to the task,

and was able to choose a small inexpensive gift, such as a toy car, pencils or doll, as a token of appreciation after they completed the task.

A few younger children had questions about the process before they participated. Some waited until after they had seen their peers participate before taking part. Most appeared to enjoy participating in this event which was outside their daily experience. They were reassured that if they wanted to stop at any time during the picture naming task, they would be able to do so.

Each transcription was checked with the research assistant. The phonetically comprehensive SIL Phonetics Practice Tool (SILA, 2016) was the constant point of reference for all uncertainties in transcription both during the initial transcription and subsequent analyses, when the recordings were consulted again. This tool gives an audio recording for each IPA symbol. The Phonetics Practice Tool was consulted with the research assistant, with reference to the original transcription and the recording, until consensus could be reached. If there was no consensus, the judgment of the native speaker was followed.

5.6 Measures and Materials

All data was recorded using an Olympus LS-12 Linear PCM Recorder voice recorder. All sound recordings were backed up to a laptop and a one terabyte disc drive at the end of each session.

The picture book developed in the final stage of the child pilot study, Book 3, was used to collect the single word naming data. Single words were targeted in the first section of the task and 65 of these words were analysed. After the single word naming, a picture sequence task had been added to stimulate spontaneous word production. Of the words and phrases targeted in

the picture sequence narrative task in the second section, two words were reliably elicited; 'balus' (aeroplane) and 'bilas' (decoration), so these were the only words included in the analysis.

The 67 target words for every child's dataset were identical, although elicitation rates were not the same for every child. Responses were recorded for each child and each word, identifying whether the word was elicited spontaneously, with a model, or not elicited at all. This was included in the transcription and analysis (Appendix N).

5.7 Transcription

Phonetic transcriptions of the children's responses by the researcher using the International Phonetic Alphabet (IPA) were commenced at the time of data collection. Recordings were subsequently re-transcribed with a narrow IPA transcription into an Excel workbook from the recordings and online notes. During the earlier transcriptions the research assistant and researcher worked together to ensure consistency of transcription. Following this, transcription was completed by either native speaker or researcher separately, followed by checking 75%-100% of each transcription by either the researcher or together. The research assistant provided valuable insight into the presence of substrate elements in the children's speech and supported the researcher in her understanding of Melpa phonology, which the researcher had studied during a Summer Institute of Linguistics Australia (SILA) phonetics training course prior to data collection and transcription.

5.8. Reliability Measures

To examine inter-rater reliability, 10% of the samples were independently transcribed by an independent Australian SLP in PNG, who

spoke fluent TP and was able to transcribe in IPA. Agreement rate for the 10% independent IRR was calculated by dividing the number of conflicts in transcription by the total number of transcription cells. The agreement rate was 97%.

5.9. Analyses

Following transcription of all samples, independent and relational analysis were conducted.

5.9.1 Independent analyses.

5.9.1.1 Phonetic analyses. The first research question asks if the phonetic inventories and phonotactic structures will change with chronological development. In order to address this research question, phonetic inventories were derived from phonetic transcription of the single word picture naming task. Phones were recorded by syllabic position, the SIWW position included three possible syllabic positions in our word sample, depending on how many syllables the word contained. These three SIWW positions have been conflated into a single SIWW category for the purpose of the phonetic and phonological analyses.

The criterion for inclusion in a child's phonetic inventory required sounds to be produced at least twice in the child's sample in any syllabic position (Gildersleeve-Neumann et al., 2008; Robb, Psak, & Pang-Ching, 1993; Stoel-Gammon, 1985, 1989). Percentages of phones produced by each twelve month age group, in each syllabic position, were then generated. The criterion for inclusion in a 12 month age group was based on the criterion of 75% of the age group producing the sound (Gangji et al., 2015; Hua & Dodd,

2000; Templin, 1963). Phonetic inventories were tabulated with attention to segmental features such as voicing, place and manner. The group of phones that appeared in all phonotactically permissible syllabic positions in each age group were noted.

5.9.1.2 Phonotactic structure. Analysis of phonotactic structures examined the consonant and vowel structure of words. These were identified from each participant's single word data (Robb & Bauer, 1991). The phonotactic structures recorded for each twelve month age-group was then tallied from the sample. A participant was credited with a structure if they used it once, and the age group were considered to have mastered the structure when it was used by 85% of the age group (Maphalala et al., 2014). Target words included two variant forms which were both included in the analysis. Variant word forms included for analysis were /faipla/ and /faiv/, 'five' and /sıkarapım/ and /skreipım/ 'to scrape'.

5.9.2 Relational analyses. The second research question examines changes in phonology with age and the fourth question asks if the phonology reveals universal patterns in the precedence of unmarked phonemes in phonological acquisition. These questions were answered with reference to the relational measures of phonological inventories for each age group and the precedence of phonemes as indicated by the percentage of children acquiring them in each age group.

Phonological inventories measure phones used contrastively, to carry meaning (Goad & Ingram, 1987) and are a measure of children's use of phonemes as part of their language skills. The children's phonological acquisition was measured in relation to the adult phonological use derived

from the adult pilot study. The broad transcription of target phonetic data was summarised for each participant into a 67-line dataset. This 67-line dataset in the Excel workbook was analysed for each child, to collate segment target attempts and successes and generate individual percentage consonants correct data. This in turn allowed preparation of a single line of data per participant for entry into SPSS (IBMCorporation, 2017)(Version 25. 2017).

5.9.2.1 PCC analyses. For each participant, consonant accuracy was measured using Percentage Consonants Correct (PCC) (Shriberg & Kwiatkowski, 1982). There were accepted variants, for example in aspiration, and target word pronunciations for PCC were decided on the basis of the adult pilot study. When distortions were infrequent in the adult population, as for example with the [ɬ] substitution for [l] or [s], it was not a match, and noted as a phonological process during phonological process analysis. The number of target consonants produced correctly in relation to the adult targets was divided by the total attempts and this number converted to a percentage. The mean PCC for each of the four twelve-month age groups was calculated in Excel.

The PCC for each participant was entered into SPSS in order to calculate descriptive and inferential statistics. Descriptive measures of PCC were obtained for the group as a whole and for each twelve-month age group. Boxplots demonstrating the median and interquartile range were also obtained for twelve month age-groups, to clarify distribution of PCC in the age groups. The assumptions of independence, normal distribution and homogeneity for one-way between groups analysis of variance (ANOVA) were tested prior to conducting an ANOVA. Participant data was independent, normal distribution

of the PCC was examined with the Shapiro-Wilk test, descriptive statistics, histograms and boxplots. Homogeneity of variance was examined with Levene's test.

An ANOVA was used to investigate the impact age group had on mean PCC. Post hoc Tukey's HSD tested the significance of individual 12-month age-group comparisons. The omnibus effect size was obtained with η2 and Cohen's D was calculated to assess effect size for each age group comparison.

5.9.2.2 Phonological inventories. This was a relational measure of the children's success in achieving adult consonant targets in each appropriate syllabic position. It was based on the following metric which accommodated variation in frequency of opportunities and rates of elicitation. A phoneme was considered correct if the participant achieved 100% correct in two or fewer opportunities and at least 67% correct in three or more opportunities (Hua & Dodd, 2000; Mahura & Pascoe, 2016).

Group phonological inventories were obtained both for acquisition of the phoneme when 75% of the twelve-month age group had the sound correct and for mastery or stabilisation when 90% of the age group had the sound correct (Amayreh & Dyson, 1998; Hua & Dodd, 2006b, p. 17). Group phonological inventories were tabulated by four syllabic positions (SIWI, SIWW, SFWW, SFWF) in which they were correct for the targeted percentage of children. Phonemes correct in every targeted syllabic position for each 12-month age group were also noted. Examination of these inventories provided information about order of acquisition of phonemes and the differences in patterns of acquisition according to syllabic position as revealed by the syllabic position analyses in each age group.

The Early, Middle And Late descriptors (EML) were used to provide further detail of the phonological inventories of the participants (Shriberg et al., 1997). Categories are defined as follows: Early sounds are seen in 75% of three year olds in a population, Middle sounds are between 25% and 75% of three year olds, and Late sounds are seen in less than 25% of 3-year-olds (Shriberg, 1993; Shriberg et al., 1997).

Additional descriptive measures included a tabulation of the percentages of consonant and consonant clusters acquired at each age group and the range of ages each phoneme was acquired. The range from 50% of an age group (customary production) to 90% of the age group (mastery) (Hua & Dodd, 2000) for each phoneme was prepared to demonstrate the variation of phonological acquisition in this population (Sander, 1972).

5.9.2.3 Phonological processes. The third research question asks: "Are there differences in the phonological processes children use with age?" Error patterns are considered to be driven by universal principles of speech acquisition (B. Dodd & Iacano, 1989).

The entire data base was examined in Excel word by word for each participant and all processes were recorded. An audit of processes seen at least once, including the common and uncommon processes reported in the literature (Grunwell, 1987; Roberts, Burchinal, & Footo, 1990), formed the basis of the processes subjected to analysis. A process was considered present if it appeared five times in a child's word sample (W. Cohen & Anderson, 2011; B Dodd et al., 2003). This criteria was more stringent than some smaller studies which only required a process to appear once in a child's sample (Maphalala et al., 2014). A process was considered active in an age group if

10% or more of the cohort (Hua & Dodd, 2000; Topbas, 1997), (or two or more children in a twelve month age group) had the process present.

5.9.3 Gender analyses. Question five asks if there are differences in the phonological acquisition of boys and girls. To address this question descriptive statistics for gender and PCC were examined, and an ANOVA of PCC for gender and age were calculated with a univariate analysis of means.

The results for each of these analyses are outlined in chapter six, the discussion of those results will follow in chapter seven.

Chapter 6. Results

6.1. Independent Analyses.

The first question asked: "Are there differences in the phonetic inventories and phonotactic structures in each age group?" It was hypothesised that phonetic inventories and phonotactic structures would increase with age. Independent analyses of narrow phonetic inventories and phonotactic structures were employed to answer the question.

6.1.1. Phonetic inventories. Phonetic inventories for each age group, based on analysis using a broad phonetic transcription, are reported in Table 19. Clusters are not included as the only cluster which had multiple targets and satisfied the 75% criteria was [pl]. This appeared in both target syllabic positions; SIWW and SFWF, for all age groups.

Sounds present in an age-group in all possible positions are displayed in the final column of Table 19. There were larger inventories of phones in the SIWI position, with the smallest phonetic inventory observed for the syllable final within word (SFWW) position. Onset syllabic positions were the only place the voiced stops bilabial [b] and coronal [d] were seen in the 3-year-old group. The SFWF position of velar nasals was not seen in any age group in contrast to the wide distribution of the bilabial and coronal nasals in the 3-year-old age-group onwards.

Table 19. Consonant Phonetic Inventories by 12 Month Age-groups.

Age group	SIWI	SIWW	SFWW	SFWF	All available positions
3YO	p, b, t, d, k f, ʤ w l m	p, d, k, ʤ w, l, ɾ m, n	 m, ŋ	b, d s w, l m, ŋ	d ʤ w, l m, ŋ
4YO	p, b, t, d, k s, f, ʤ w, l, j m	p, t, d, k ʤ w, l, ɾ m, n	 n, ŋ	t s l n, ŋ	t, d ʤ w, l m, n
5YO	p, pʰ, b, tʰ, d, k, kʰ f, s, ʤ w, l, j m,	pʰ, b, tʰ, d, kʰ s w, l m, n	 l n, ŋ	tʰ, kʰ s l, ɾ m, n	b, tʰ, d, kʰ s w, l m, n
6YO	p, pʰ, b, tʰ, d, kʰ f, s, ʤ l, j, w m	pʰ, b, tʰ, d, kʰ s, ʤ w, l m, n	 l n, ŋ	 tʰ, kʰ s l, ɾ m, n	pʰ, b, tʰ, d, kʰ s, ʤ w, l m, n

Note: Phones appearing more than once in 75% of their age group.

Voiced and voiceless plosive groups were only represented in the 6-year-old group's inventory. The voiced velar plosive /g/ did not have more than one opportunity in each syllabic position, so did not satisfy the strict international criteria of appearing twice in a syllabic position for 75% of the individual participants in an age group. It therefore does not appear in the phonetic inventories. Aspirated plosives were seen most frequently in the older two groups. Voiceless plosives in the older two age groups tended to be aspirated, in comparison to unaspirated plosives in the three and 4-year-old age group.

There were some differences between age groups in the presence of different manners of articulation. Bilabial and coronal plosives were acquired from three years on in more than one syllabic position. The voiced affricate

[ʤ] was the first phone with a fricative component to appear in more than one position in the 3-year-old group. Unvoiced coronal fricative [s] appeared in more than one syllabic position from the 4-year-old age group onwards. The lateral approximants [l] and [w] were present in more than one syllabic position from three years onward. The palatal glide [j] was acquired from the 4-year-old group onwards. The acquisition of the flap [ɾ] was not linear and other forms of the /r/ phoneme did not have significant percentages in these phonetic inventories. The flap was present only in the SIWW position in three and 4-year-olds but only in SFWF position in 5 and 6-year-olds.

6.1.2 Phonotactics. The percentage of children who had mastered each word-shape present in the target words is reported in Table 20.

All phonotactic structures of three or less syllables were mastered by all the age groups. The two and three syllable words were mastered by the 3-year-old group with the exception of 'tupla', which had a variant form 'tupela'. The four-syllable multisyllabic words /pıkınıni/ and /sıkarapım/ were not mastered before six years. Bi-syllabic words with consonant blends, such as 'draiva' or 'tupla', although mastered by the groups, generally had lower group scores.

Alternate word form /tri/, 'three' appeared in 22 occurrences over all four groups, although it was not originally included as a variant form to measure. For example, six 3-year-olds produced /tri/ and 14 three year olds produced /tripla/. There were two other alternate forms included in analyses: /faiv/ and /faipela/, 'five' and /skreipım/ and /sıkaɾapım/, scrape'. Table 21 shows a summary of variant word form distribution.

Table 20. Phonotactic Development: Phonotactic Structures Mastered[1] by Age Group.

Phonotactic structure	Syllables	Sample words	Gloss	Percentage correctly used by age group.			
				3YO	4YO	5YO	6YO
CVC	1	kar	car	100	100	100	100
CCVC	1	blek	black	100	100	100	100
CV CV	2	diwai	tree	100	100	100	100
CV CVC	2	wasɪm	wash	100	100	100	100
CVC CV	2	kundu	drum	100	100	100	100
CVC CCV	2	jaŋpla	young	95	100	95	100
CV CCV	2	tupla	two	75	100	90	95
CVC CVC	2	sɪŋsɪŋ	sing	100	100	100	100
CCV CV	2	draiva	driver	90	90	100	100
CV VC CV	3	piendʒi	PNG	90	90	95	90
CV CV CV	3	banana	banana	95	100	100	100
CVC CV CV	3	solwara	sea	85	95	90	95
CV CV CVC	3	kokonas	coconut	100	100	100	100
VC V CVC	3	onijon	onion	95	95	100	100
CV CV CV CV	4	pɪkɪnɪni	child	50	70	75	75
CV CV CV CVC	4	sɪkarapɪm	scrape	55	75	65	80

Note 1: Age group mastery is indicated by shaded areas showing where >85% of children used the phonotactic structure correctly.
Note 2: 'Mastered'[1] means 85% of the age- group used this structure at least once.

Table 21. Variant word form distribution by age group.

	Form attempted					
	/tri/	/tripla/	/faiv/	/faipla/	/skreipɪm/	/sɪkarapɪm/
3 YO	6	14	16	4	1	14
4 YO	9	11	5	15	2	17
5 YO	6	14	13	7	2	16
6 YO	1	19	11	9	5	15
Total	22	58	45	35	10	62

6.2 Relational analyses

Relational analysis was used to answer question two; "Are there differences in phonological development between each of the age groups?" It was hypothesised that phonological development would change with chronological development. Analyses included phonological inventories, phonological developmental process inventories and PCC.

6.2.1 Phonological inventories. Phonological inventories were calculated using the two out of three or 67% correct metric for individual acquisition of a phoneme, which has been used in studies in less researched languages (Hua & Dodd, 2000; Mahura & Pascoe, 2016). When there were less than three opportunities to use a phoneme, participants were credited with a phoneme when it was 100% correct, and when three or more opportunities to use the phoneme existed, when it was at least 67% correct. Phonological inventories were prepared for each age group, according to syllabic position, for both the 75% group acquisition rate (Table 21) (Anderson & Smith, 1987) and the mastery group acquisition rate of 90% (Table 22) (Hua & Dodd, 2000).

There were differences in acquisition according to syllabic distribution (Tables 22 and 23). Phonemes that were acquired in all syllabic positions sampled by age group are indicated in the last column.

Acquisition of phonemes showed differences in numbers and content between the age groups. A progression with age was most evident for plosives. There were three plosives correct in all possible positions for three, four and 5-year-olds, but they differed, with three and 4-year-olds having alveolar and velar plosives, and 5-year-olds adding a bilabial /p/ in place of /t/. There were five plosives mastered in all positions for the 6-year-old group.

The labio-dental fricatives /f/ and/v/ were the fricatives mastered in all tested positions until age six. The 6-year-old group added the alveolar fricative /s/ in all positions.

Two approximants; /w/ and/ j/, were mastered in each available position for all age groups. In the 4-year-old group they were joined by /l/. Three nasals were mastered in all positions by the 4 to 6-year-olds, but the 3-year-olds lacked the velar nasal.

Table 22: Phonological Acquisition Inventories by Syllabic Position (75% of Age-group) (Anderson & Smith, 1987).

Age band	SIWI	SIWW	SFWW	SFWF	Correct in all positions
3YO	p, b, t, d, k, g	p, t, d, k		p, k	p, d, k
	f	f, v, ʤ		f	f,
	w, l	w, l, j		l	w, j,
	m, n	m, n	n, ŋ.	m, n, ŋ	m, n, ŋ
Clusters	bl, kl	pl			
4YO	p, b, t, d, k, g	p, t, d, k		p, t, k	p, t, d, k
	f, s, ʤ	f, v, ʤ	s	f, s,	f, ʤ
	w, l, j	w, l, r, j		l	w, j
	m. n	m, n	n, ŋ	m, n, ŋ	m, n, ŋ
Clusters	bl, kl, fl, sk	pl			
5YO	p, b, t, d, k, g	p, b, t, d, k		p, t, k	p, b, t, d, k
	f, (s lost), ʤ	f, v, s, ʧ, ʤ		f, s,	f, v, ʤ
	w, l, j	w, l, r, j	l	l	w, l
	m, n	m, n,	n, ŋ	m, n, ŋ	m, n, ŋ
Clusters	bl, dr, fl, kl, sk	pl			
6YO	p, b, t, d, k, g	p, b, t, d, k g		p, (t lost), k	p, b, d, k
	f, s, ʤ	f, v, s, z, ʧ, ʤ,	s	f, v, s	f, v, s, ʤ,
	w, l, j	w, l, r, j	l	l	w, l
	m. n	m, n,	n, ŋ	m, n, ŋ	m, n, ŋ
Clusters	bl, fl, kl, sk	pl			pl, fl, kl, sk

Note: By syllabic position and 12 month age-groups, according to 2/3 metric for individual acquisition (Hua & Dodd, 2000)

Table 23: Phonological Mastery Inventories by Syllabic Position (90% of Age-group) (Amayreh & Dyson, 1998; McLeod & Crowe, 2018).

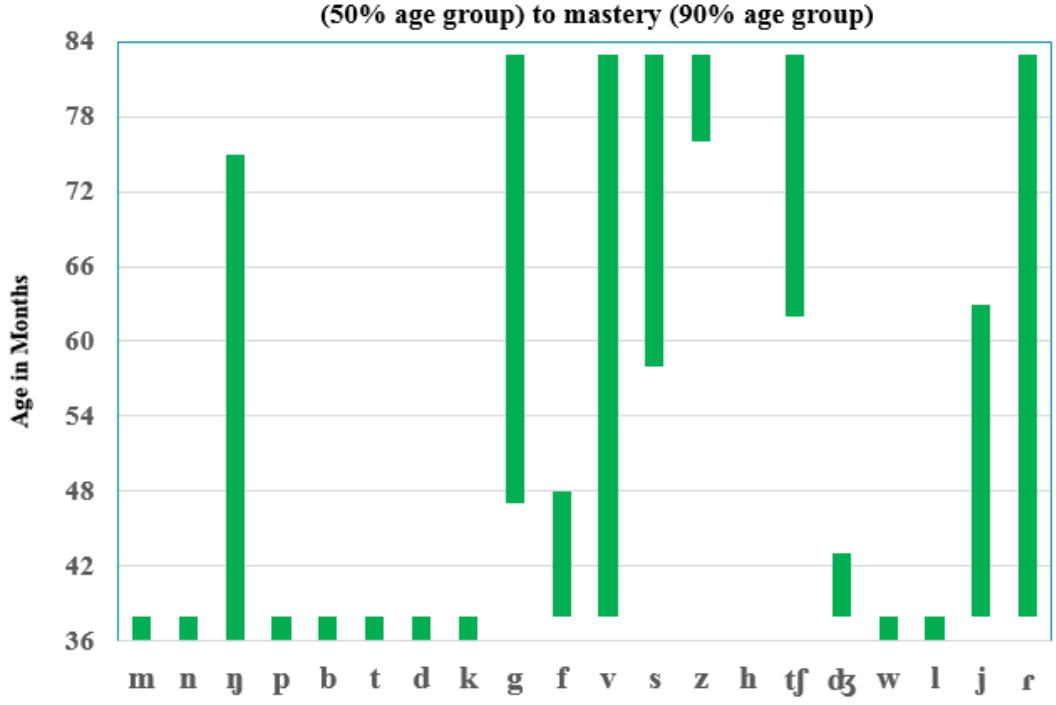
Age band	SIWI	SIWW	SFWW	SFWF	Correct in all positions
3YO	p, t, d, k, g	p, t, d, k		k,	t, d, k
	f	v, ʤ	v	f	f
	w, l, j	w, l, j			w, j
	m, n	m, n	n, ŋ	m, n	m, n
Clusters	bl				
4YO	p, t, d, k, g	p, t, d, k,		k	t, d, k,
	f, ʤ	f, v (-ʤ)	s	f l	f
	w, j, l	w, l, r, j			w, l, j,
	m, n	m, n	n, ŋ	m, n, ŋ	m, n, ŋ
Clusters	bl				
5YO	p, t, d, k, g	p, b, t, d, k		p, k	p, d, k
	f, ʤ	f, v		f	f,
	w, l, j	w, l, r, j		(l lost)	w, j
	m, n	m,	n, ŋ	m, n, ŋ	m, n, ŋ.
Clusters	bl, kl				
6YO	p, b, t, d, k, g	p, b, t, d, k		p, k	p, b, d, k, g
	f, ʤ	s, (f, v lost), ʧ, ʤ		f, s	s
	w, l, j	w, l, j, r			w, j
	m, n	m, n	n, ŋ	m, n, ŋ	m, n, ŋ
Clusters	bl, kl, tr, dr				

Note: By syllabic position and 12 month age-groups, according to 2/3 metric for individual acquisition (Hua & Dodd, 2000).

The range of ages during which a phoneme would be acquired and mastered, based on composite figures for all syllabic positions in the phonological inventories, is displayed in Figure 3. The bottom of the bars for a phoneme indicates when 50% of the children at the age in months on the

vertical axis have mastered the sound, the tops of the bars indicate when 90% of children for that month have mastered the sound.

Figure 3. Range of ages of consonant acquisition: customary acquisition (50% age group) to mastery (90% age group)



Bottom of the bars matches month 50% of participants acquired the phoneme, top of the bar matches the age 90% of participants acquired the phoneme.

Phonemes that were the earliest mastered, in 75% or more of 3-year-olds, were /m, n, p, b t, d, k, w, l/. Phonemes with a wide range of ages for mastery were /ŋ, v, dʒ, j, / and late sounds commencing 50% mastery later than age three and taking further time before they are mastered are /g, s, z, ʧ, r/.

6.2.2 Percent Consonants Correct.

Descriptive statistics examined PCC in 12 month age groups (Table 24) supported the second hypothesis that phonological inventories would increase

with age. There was an upward movement with age, despite significant variation within age groups.

Prior to administering a one-way between groups analysis of variance (ANOVA), assumption testing of normality was carried out. It was tested with inspection of boxplots, histograms and descriptive statistics (Table 23). Normal distribution was not uniformly seen in all age groups.

Table 24. PCC Descriptive statistics by 12 month age-groups.

Age group	Mean PCC	Median	Standard Deviation	95% Confidence Interval	Range
3YO	83.46	85.23	7.81	79.80-87.11	62.5-93.3
4YO	89.05	88.48	4.52	86.93-91.16	80.6-100
5YO	89.93	90.73	5.90	87.17-92.69	69.6-96.3
6YO	92.38	92.61	2.92	91.01-93.75	88.1-98.8

Skewness and kurtosis were within normal limits for the 4-year-old (.436) and 6-year-old groups (.460), close to acceptable for the 3-year-old group when standard error was considered (1.26, SE .51), but significant (George & Mallery, 2010) in the 5-year-old group (-2.22, SE .51: 7.07, SE .99). There were overlaps in range between all age-groups with larger standard deviations and 95% confidence interval ranges in both the 3-year-old (M= 83.46, range 30.8, SD 7.81) and 5-year-old age groups (M =89.93, range 26.8, SD 5.90). Five-year-old group variance (35.34) was high. Upward movement with age was clearer with the median than the mean. Levene's statistic was significant for the mean f (3, 76) = 3.58 (p=.02) but not violated for the median (p= 0.61). The Shapiro-Wilk test (Table 25) indicated that the

assumption of normality was supported for each group (p= >.05) except the 5-year-old group (p=001).

Inspection of the boxplots for each age group showed low outliers in the 3-year-old (z= -4.10) and 5-year-old groups (z score = -2.99).

Table 25. Shapiro–Wilk Test: PCC of 12 Month Age Groups.

Group	Shapiro-Wilk		
	Statistic	df	Sig.
3 years	.90	20	.05
4 years	.97	20	.77
5 years	.80	20	.00
6 years	.95	20	.42

ANOVA is robust with respect to moderate violations of the assumption of normality (P. Allen, Bennett, & Heritage, 2014; Beuckelaer, 1996) and homoscedasticity, particularly in the presence of equal sample sizes (P. Allen et al., 2014; Olejnik, 1987). Therefore, a One-Way between groups Analysis of Variance (ANOVA) was used with the unadjusted dataset to investigate the impact age group had on mean PCC. The ANOVA was statistically significant indicating that children's PCC scores were influenced by their ages, $F(3, 76) = 9.12$, $p<.05$), $\eta^2 = 0.27$. However, this calculation must be considered in the light of the heterogeneity of variances around the mean. The ANOVA was repeated with the outliers removed with the same pattern of findings, $F(3, 76) = 9.96$, $p<.05$.

Post-hoc analysis using Tukey's HSD (using $\alpha = .05$) as shown in Table 25, revealed that the 3-year-old group (M= 83.46, SD = 7.81) had significantly

lower PCC scores than the 4-year-old group (M= 89.05, SD= 4.52), the 5-year-old group (M= 89.93, SD= 5.90) and the 6-year-old group (M= 92, 38, SD =2.92). (Table 26).

Table 26: Post-hoc tests, PCC. Tukey's HSD.

(I) year groups	(J) year groups	Mean Difference (I-J)	Std. Error	Sig. *
3 YO	4 YO	-5.59*	1.77	.01
	5 YO	-6.48*	1.77	.00
	6 YO	-8.93*	1.77	.00
4 YO	3 YO	5.59*	1.77	.01
	5 YO	-.88	1.77	.96
	6 YO	-3.33	1.77	.24
5 YO	3 YO	6.48*	1.77	.00
	4 YO	.88	1.77	.96
	6 YO	-2.45	1.77	.51
6 YO	3 YO	8.93*	1.77	.00
	4 YO	3.33	1.77	.24
	5 YO	2.45	1.77	.51

**Note: significant at α =.05*

A univariate analysis of ANOVA was used to calculate an omnibus measure of effect size (η2 =.27). According to Cohen (J. Cohen, 2013) this is a large effect size for Cohen's F. We can attribute 27% of the difference in PCC between age groups to age differences. Effect sizes for the three comparisons between 3-year-olds and 4-year-olds (D = 0.72), 3-year-olds and 5-year-olds (D = 0.84), 3-year-olds and 6-year-olds (D =1.16) ranged from medium to large. Comparisons not involving the 3-year-olds weren't significant at the p=.05 level. Effect sizes for comparison of the 4-year-olds with the 5-year-olds group were medium (D = 0.57), effect sizes were small for the last two

comparisons, 4-year-olds to 6-year-olds (D = 0.43) and 5-year-olds to 6-year-olds (0.43).

The Early, Middle and Late phonemes calculated using PCC, as described by Shriberg (1997), showed an increase in size and range of phonemes with age, further supporting the second hypothesis. The EML categories of phonemes measured by PCC in percentage bands calculated by Shriberg (1993) and subsequently applied in bilingual populations (Ruiz-Felter et al., 2016) were as follows: Early (>75% at age three): plosives: /p. b, t, d, k/, early fricatives: /f, ʤ/, early approximants: /w, l, j/, early nasals /m, n, ŋ/. Middle sounds (74%-25% at age three): calculated by PCC were /g, v, s, ʧ, r/. Late sounds (<25% at age three): were the non-target sounds /z, h/.

6.2.3 Phonological Process Analyses. Data on phonological processes addressed research Questions three and four. Question three asked if the inventory of processes would change with chronological age. Question four asked if the nature of the processes reflected universal principles.

Initial tallies of processes, based on a criterion of one instance, were prepared in Excel. When multiple processes were evident in a word, all were counted, as per Grunwell (1987, p. 226). Analysis of frequent articulatory changes such as distortions in the population were analysed as 'phonological processes'. More precisely targeted research is required to identify whether these were articulatory or phonological events. The processes found were reduced to three syllable structure processes: vowel deletion, consonant deletion and cluster reduction and twelve substitution processes: voicing or de-aspiration, stopping, dentalisation, palatalisation, fricatisation, lateralisation,

deaffrication, liquid confusion, glottal replacement, backing, fronting and de-voicing. This inventory of processes was inclusive of every variation from classic TP and did not exclude at this point processes which may be indicative of local TP or substrate influence. These processes were then analysed using the criterion of five instances in a child's inventory and 10% of an age band's participants.

Not every process was present in every age band when subjected to our criteria of five instances in 10% or more of the age band. Tabulations for syllable structure processes (Table 27) and substitution processes (Table 28) show that substitution processes were more frequent. Both categories of processes showed a decline in process occurrence with each age-group.

The most frequent syllable structure process, and the only one active in a group, was vowel deletion (Table 27). There were four further processes in 10% or more of the age groups if the *more than once* criterion was employed, notably *syllable deletion* which appeared in >10% of all age groups and *epenthetic vowel insertion*, which appeared in the three to 5-year-old age groups. The syllable structure processes showed a decrease in age with the 3-year-old group showing the most processes. There was no difference between the 4 and 5-year-olds but in the 6-year-olds all syllable structure processes were not significant by the criteria used. An exception was vowel deletion seen more than once (Gangji et al., 2015; Mahura & Pascoe, 2016; Maphalala et al., 2014) in 36 participants, 17 of whom were in the 6 year old group (85%)

Table 27: Syllable Structure Processes by 12 month age-groups

Process	Vowel deletion	Active (A) or not (NA) in group	Children showing Consonant deletion	A or NA in group	Children showing Cluster reduction	A or NA in group	Age group total
Target	kakaruk		dıgım		Blek		
Example	kakruk		dıgı		bek		
3 Years	1	NA	1	NA	1	NA	2
4 years	2	A	0	NA	0	NA	2
5 Years	1	NA	1	NA	0	NA	2
6 Years	0	NA	0	NA	0	NA	0

Note: A process is active in an age group when two or more children exhibit the process.

Substitution processes (Table 28) also decreased progressively with age, thus confirming that age is the major influence on the presence of processes. The exceptions were backing, fronting and dentalisation, which had no clear age-related effect. The only two processes active in every age group were voicing and deaspiration and stopping. By the 6 year old group, only one process was active: fricatisation.

Substitution processes overall were dominated by variation in voicing or aspiration in the two youngest groups. The four next largest groups of processes seen were respectively: lateralisation, fricatisation, deaffrication and liquid confusion. Liquid confusion was a /l/ substitution for /r/. In 10% or more of children the substitution processes: pre-nasalisation of stops (eight participants) and de-voicing (34 participants) were seen more than once, but not the requisite five times.

Table 28. Substitution Processes

Process*	Target	Example	3 YO	4 YO	5 YO	6 YO	Total in sample
Voicing or de-aspiration	klaut^{h}	klaud	17	18	3	7	45
Stopping	solwara	ɬolwada	5		2		7
Dentalisation	waswas	wat̪ wat̪	1		2		3
Palatalisation	laulau	ʎaulau	3	1	2		6
Fricatisation	balus	baluɬ	4	1	4	2	11
Lateralisation	jizas	ʝiɬaɬ	8	4	2		14
De-affrication	ʤmdʒa	dmda	4	3	2		9
Liquid confusion	wara	wala	4	2	2		8
Glottal replacement	haus	ʔaus	4	1	2		7
Backing	tɪsu	tɪʃu			2		2
Fronting	sŋsŋ	smsm			1		1
De-voicing	beibi	beipi	1	4	2	1	8
Total for age group			51	34	26	10	121

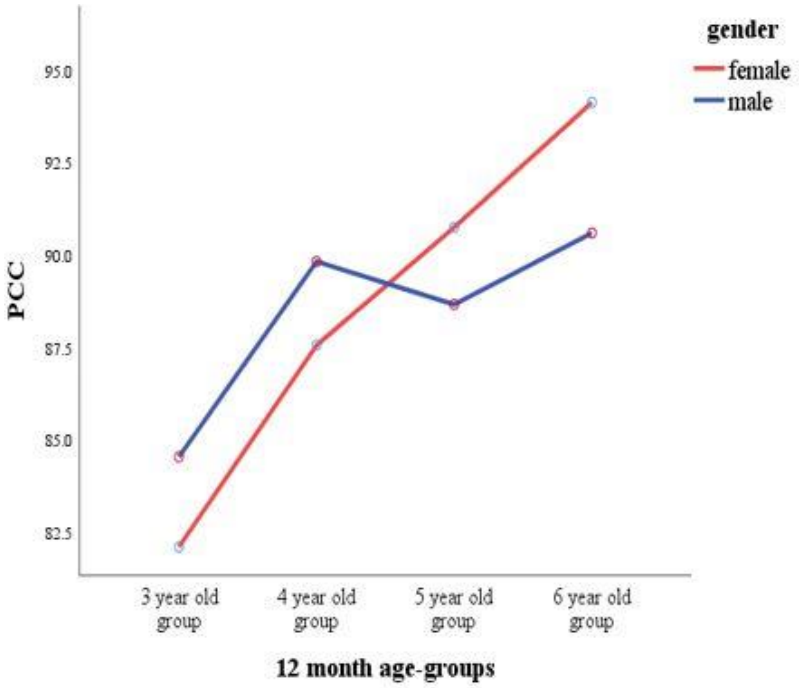
**Note: A process is active in an age group when seen five times in two or more participants.*

6.2.4 Gender differences, PCC statistics. The fifth research question asked if there are differences in the phonological acquisition of males and females and hypothesises that there will be a difference. The relationship between PCC and gender at each age group is demonstrated in Figure 4.

PCC statistics showed a higher median than mean for both males and females with SD for males (5.64) lower than for females (7.19). Inspection of boxplots reveal a negative skew in both distributions. Both skew (12.27, S.E.: .37) and kurtosis (10.32, S.E.72) were higher for males. Inspection of boxplots and histograms for gender revealed an extreme outlier in the low 60s (participant 42) for the male distribution. Differences between the genders changed slightly with age. The mean PCC of girls was lower than for the boys in the three and 4-year-old age-groups (Figure 4; red), but higher than the boys in the 5 and 6-year-old age groups (Figure 4, blue).

A factorial between groups analysis of variance (ANOVA) was used to investigate the effects of gender and age group on mean PCC scores. Levene's test (α =.05), F =2.07 (7.27), p =>.06 found the assumption of homogeneity of variance was not violated. The ANOVA revealed no significant effect in the age groups' mean PCC for gender, F (3, 72) = .033, p>.06, $\eta 2$ = .00. The nature of the interaction is illustrated in the plots in Figure 4.

Figure 4. PCC by gender and age group.



Scrutiny of all the results obtained, with attention to different variables and of the criteria used sheds light on the nature of phonological acquisition in this creole TP-speaking population. These considerations and the implications of the results of this study will be discussed in chapter seven.

Chapter 7. Discussion

This programme of research has provided preliminary data on TP phonological development in the diverse sociolinguistic mix of children in the PNG Highlands. Developmental changes were seen with age in phonetic, phonotactic and phonological inventories. Some language specific outcomes related to the rules of TP were seen and the influence of the other two languages in the mix; English and the substrate, Melpa, were also evident.

As we considered research questions one to three, we found that the changes in phonetic, phonotactic and phonological inventories were age related. Presence of phonological processes also declined with age, as was expected. However, there was a high level of variation within age groups, and although there was a general upward progression seen in inventories and PCC scores, this also included overlaps between age groups, as the descriptive statistics illustrate. Age was clearly not the only factor impacting the articulatory patterns and phonological development of this population. The high range of variation in the PCC scores in each age group (Table 22), shows that, as well as maturational factors, other elements are at play. These could include family and language use characteristics (see Appendix K for details), but further detailed research focussing on these areas is required to confirm or refute this possibility.

This was not a sociolinguistically homogenous group with an equal mix of the three language types in use. It could be argued that such a group

would be impossible to source in urban and semi urban PNG. The sociolinguistic complexity both within and between age groups, which the language use and occupational surveys pointed to, echoed the statistical variation seen in distribution of PCC. Closer examination of the phonetic and phonological inventories and the types of developmental processes evident in this population, gave indications of the reasons for this statistical heterogeneity, and therefore the results will be examined in more detail.

7.1 Independent Analyses.

7.1.1 Phonetic Development. Question one asked about the changes in the phonetic inventory with age. The independent analyses undertaken to examine the impacts of age on the phonetic inventories and development of phonotactic structures with age, showed early mastery of most segments and structures. The phonetic inventories showed that by age three, 13 of the 20 possible consonant phones for TP were mastered. The 3-year-olds had phones from each of the manners of articulation in the phonology, and the number of phones seen in each possible syllabic position increased with age. The 5-year-old group used 15 different phones, but they were a different group of phones and did not include all those seen in the younger groups. Different phonetic inventories may be seen in younger children as phones from the other languages appear in the phonetic inventory. In a well-researched language, in a monolingual population with a clearly established set of phonological targets, most clinical discussion would focus on an increasingly large percentage of that phonological inventory being correctly articulated (Dodd et al., 2003).

Whilst some phones were added to the inventory and remained present throughout, progress was not linear for every sound, with sounds sometimes present in an age group and then absent in an older age group. Linear development was seen in the development of plosives, which saw further inventory content and the aspiration feature added in the older groups. Aspiration is not contrastive in TP and, in this population, unaspirated plosives are more widely used, reflecting the substrate phonologies. Aspiration of plosives was a linear function of age. In the 5 and 6-year-old age group, higher percentages of children articulated aspirated plosives in all positions than in the 3 and 4-year-old age groups. It appears that the aspirated plosives may be more marked, even when the feature is not contrastive in TP, as it is in languages that have contrastive aspiration (Hua & Dodd, 2006c). The pattern in this study may indicate that the older children's greater exposure to English speakers after they had been at pre-school and elementary school, may lead them to add English forms such as aspiration to their phonetic repertoires. Great care was taken in the transcription of the plosives, with the researcher and research assistant listening together to reach consensus, but it is an area that would profit from confirmation with acoustic analysis in future studies.

Another linear development was the phone [ɾ] which was not seen until the 5 and 6-year-old groups. The absence of the flap [ɾ] in younger age groups' phonetic inventories, would most obviously be attributed to the universal lateness of /r/ forms, but it should be noted that, in addition to the flap [ɾ], the trill [r] and the English semivowel [ɹ] were seen in this

population, with the flap being the preferred form. The APiCS structural dataset is the only reference in the literature to TP /r/ use (Smith & Siegel, 2013). It only lists the trill and the flap, possibly indicating that this population is revealing the first recorded signs of the English alveolar approximant [ɹ] in use. The children in the 3-year-old group tended to use all three as both single consonants and in clusters. Some also dentalised the flap, indicating possible Melpa influence. In the older age groups fewer variants were used and these more frequently. One interpretation for the absence of the flap [ɾ] in younger age groups may be the younger children's exploration of other /r/ forms in the phonetic inventory of TP as they ranked and re-ranked the feature hierarchy constraints of their multiple languages (Kehoe, 2011). The development of nasals in the phonetic inventories appears to be linear, limiting [ŋ] to the SFWW position in all the age groups. However, when we examined single instances of SFWF [ŋ] it appeared in SFWF in for over 75% of each age group, so appears to also be impacted by the limited opportunities and criterion of twice or more occurrences for inclusion.

Fricatives were overall less linear in their development than other manners of sounds. This was evident in the alveolar fricative [s], absent in the3-year-olds, but present in the 5 and 6-year-olds. Some linear differences were limited to syllabic positions as we saw in the slightly later appearance of fricative [s] for SIWI than SFWF position. Labiodental fricative [f] appeared earlier in the SIWI inventory from the 3-year-old age group

onwards but occurred later for SIWW and SFWF, only appearing in all possible positions in the5-year-old inventory.

A non-linear pattern of interest was the appearance of voiced affricate [ʤ] in the three and 4-year-old age-groups. It was absent in the 5-year-olds, but re-appeared in the 6-year-old group in all possible positions. The voiceless labio-dental fricative [f] only appeared in the inventories in the SIWI position for all age groups. This result for [f] and [v] must be considered in the light of the fact that labiodental fricatives in SIWW and SFWF positions were less frequent in the target words. One interpretation of the result is, although phones were recorded wherever they occurred, the fact that there were occurrences of /f/ and /v/ appearing once in all age groups at 85% or more for the less frequently occurring positions, suggests that the limited distribution of these labiodentals in the phonetic inventories was an artefact of the criterion measure and limited opportunities for these phones.

Some characteristics of the phonetic inventories showed age progression, but not in numbers that reached the 75% group criterion. These are nevertheless worthy of mention because they illustrate the diverse influences on these children's developing phonetic skills. In a preliminary multilingual study, we need to measure more than articulatory acquisition of phonological targets. The phonetic inventory is an important tool to highlight the developing child's differentiation of their multiple phonologies. Some substitutions at percentages below 75% may be less inaccurate approximations than reflections from children's other phonological subsets.

An interesting phenomenon in this population was the appearance of the alveolar lateral fricative [ɬ] which were also seen in the adults of the pilot study, albeit in in smaller percentages (Appendix D. Table D1.). It occurred in higher percentages in 3-year-olds in all positions, up to 35%, but was seen in all age groups in each syllabic position. The percentages in each age group progressively declined with age. In languages where [ɬ] is not part of the phonetic inventory it would be regarded as either a lateralisation or fricatisation phonological process. These processes are infrequent enough that they rarely feature in developmental studies (Bland-Stewart, 2003; Ceron, Gubiani, de Oliveira, & Keske-Soares, 2017b). Closer examination of the data showed 18 out of 20 3-year-old participants in this study used [ɬ] at some point. The percentages of targets realised as [ɬ] ranged from 25% to 100% of targets but only participant eight did not successfully produce the target sound at any point. Thus 18 of the 20 the 3-year-olds used [ɬ] but only one was unable to articulate the targets of [s] or [l] or [ʤ] for which it was substituted, suggesting that this was not purely an issue of motor skills with the possible exception of participant 8[2]. It should be noted that [ɬ] substitutions for fricatives and laterals were also seen in 84 instances in the 40 5 and 6-year-old participants. It seems possible this is bilingual phonological interference (Khattab, 2006) from Melpa, but this connection would require targeted research in the future . The high occurrence of [ɬ] as a substitution in this TP group is of interest because of its possible link to the substrate phonetic inventory (Ladefoged & Maddieson, 1996).

[2] Participant 8 had generalised difficulty articulating sibilants.

Fricatisation is a frequent variant of Melpa laterals in dental, alveolar and velar positions, particularly in SFWF positions where laterals de-voice and become lateral fricatives (Ladefoged & Maddieson, 1996). In differentiating articulatory and phonological developmental difficulties, articulatory errors are considered to relate to a lack in the motor system but phonological errors are a failure of the cognitive process (B Dodd, Reilly, Ttofari, & Morgan, 2018).

7.1.2 Factors impacting phonetic findings. There was wider variety of phones only used by a small number of children within the 3-year-old cohort's inventory than in older age groups. These included some substrate phones. Generally the number of phonemes in young children will increase with age as was found in a study of the phonetic inventories of Arabic-speaking infants of 14-24 months (Amayreh & Dyson, 2000) and studies of phonetic acquisition in English children (D A Dinnsen, Chin, Mary Elbert, & Powell, 1990; B Dodd et al., 2003).

In addition the TP speakers in this study shared with many studies a priority of the group A phones (D A Dinnsen et al., 1990; Meade, 2006) consisting of anterior plosives, approximants such as [w] and [j] and nasal consonants. The study of young Arabic speaking infants of 14-24 months (Amayreh & Dyson, 2000) affirmed the priority of anterior plosives, approximants and nasals. However, they also had early acquisition of Arabic language specific[ʔ] and the [ħ]. English speakers likewise shared early acquisition of the level A phones but also had five fricatives (B Dodd et al., 2003). Setswana children (Mahura & Pascoe, 2016) and isiXhosa children

(Maphalala et al., 2014) had all the level A phones plus some language–specific phones including a high percentage of their fricative inventories.

The phonetic inventories of the TP 3-year-old speakers differed from English speakers in that they had two fricatives only, [f] and [s], but added their only affricate [ʤ]. In the English speakers inventories [ʤ] was in the middle of the acquisition range in their 4;0- 4;5 group (B Dodd et al., 2003, p. 635). The reasons for the differences in TP fricative acquisition lie partly with the reduced number of fricative phonemes, both [z] and [h] operate allophonically. However it is very possible that the early mastery of [ʤ] by TP children is partly due to the impact of frequently used word templates such /ʤɪsas/, 'Jesus' and /ʤɪnʤa/, 'ginger'. The TP speakers also share with many languages, such as Samoan (Ballard & Farao, 2008) and English children (B Dodd et al., 2003), a late acquisition of the language appropriate form of the /r/ phoneme.

However, the other contributing factor is that young children have phonetic variation in their early speech as they make articulatory approximations of target phonemes (Ingram, 1976).

We saw that there were patterns of substrate-influenced phones in our sample of 3-year-olds. It appears that, at this earlier stage of phonetic mastery of TP, they were also influenced by their other phonetic inventories as is predicted for multilingual children (Hecht & Mulford, 1982). The emergence model suggests that phonetic variation of individual phonetic inventories can be due both to intrinsic physiological factors contributing to the rate of individual acquisition, but also extrinsic factors (Davis & Bedore,

2013) which in this multilingual setting are more complex (Hecht & Mulford, 1982). In a creole language the extrinsic factor of ambient language model inputs includes, with the target language, substrate and lexifier influences. The phonetic inventories and phonological processes of the 3-year-olds showed patterns of substrate-influenced phones, such as the lateral fricative substitution and dentalisation of stops. It may be that these younger successive multilingual children, with a shorter time of exposure to both TP and English, were still trialling various phonetic forms as they learnt to distinguish the subsets of their phonetic inventories and the lexemes needed for each language used in their environment: substrate, TP and English. The older children showed a greater tendency to use phones and distribution patterns that were part of the lexifier English rather than TP. An example is the 5-year-old and 6-year-old groups' use of aspirated and voiced plosives, particularly in the coda positions in words. Thus, the influence of the substrate Melpa seen in phones such as the alveolar lateral fricative and the lexifier English may both be detected in the development of these phonetic inventories.

7.1.3 Phonotactic structures. The second half of Question one asks if phonotactic structures would change with age, and the findings affirm that the children's mastery of increasingly complex structures occurs in older age groups. We have seen that the youngest group, the 3-year-olds, had mastered all structures of two to three syllables. The three structures in the 3-year-old group with the lowest percentage of success were the four syllable CVCVCVCV 'pikinini' (50%), and CVCVCVCVC 'sikarapim' (55%) and

three syllable CVC CV CV /solwara/ 'sea' (85%) forms which were difficult for 15% of the 3-year-olds. The adjacent consonants /w/ and /l/ in solwara were a challenge for a small percentage of all age groups and resulted in structural word changes including deletions and vowel insertions.

Similar patterns of mastery of all but complex four syllable structures were seen in 3-year-old groups of Swahili (Gangji et al., 2015) and isiXhosa (Maphalala et al., 2014) children. English children were found to include cluster reduction and weak syllable deletion as typically present in 10% of the sample of 3-year-olds. Cluster reduction was active in less than 10% of each of our TP age groups.

The four syllable words also scored poorly because they are also subject to systematic changes because of creolisation processes. The alternate words with abbreviated creole word-forms such as /tu/ for /tupela/, 'two' and /tri/ for /tripla/, 'three' and anglicised forms such as /skreipɪm/, 'to scrape' and /faiv/, 'five' (Table 21), impacted the statistics for the original forms in the phonotactic structure tallies. The percentages of traditional count nouns forms; CVCCV 'tupla' and 'faipla' and CCVCCV 'tripela', were impacted most notably in the younger age groups. Although 75% of the 4-year-olds chose to use /faipla/, for 'five', this dropped to 33% for the 5-year-olds and 45% for the 6-year-olds.

Older children would have had more time to be exposed to such creole versions of vocabulary and to incorporate the newer borrowings from English into their phonology, so might be expected to consistently use 'tri', for example. However, creolisations were not always predicted by age

group. Although four of the 6-year-olds used 'skreipim'. only one used /tri/, 'three', with the other 19 preferring tripla. Thus, factors other than age were involved in the choice of these variants. The adoption of 'faiv' was stronger than the adoption of 'tri'. As with the choices over which variant of /r/ to use, there may be stylistic choices being made.

7.2 Relational Analyses.

7.2.1 Phonological inventories. The second research question explored the development of phonological inventories, hypothesising that they would change with age. The number of phonemes that were achieved in each syllabic position increased in each year group for both the 75% criterion of acquisition and the 90% mastery criterion (Amayreh & Dyson, 1998) for inventories described in chapter five. In all age groups, in both the acquisition and mastery inventories, there was evidence of the use of all but the affricate manner, as plosive, fricative, approximant and nasal manners were all seen in the data set. Although this is the case from three years on, studies of younger age groups would be of interest, and as indicated earlier, there may be a basal effect. The children also had most phonemes correct in at least one syllabic position in the 3-year-old group. The importance of age as a variable in the development of phonological inventories was also confirmed by the statistically significant changes in PCC, as measured by the ANOVA.

The individual phoneme development was mostly linear, with sounds present in subsequent age groups once they had appeared in an age group. The 6-year-old age group had acquired and mastered the most phonemes.

Examples of linear developments are; the early mastery of plosives /d/ and /k/, continuants /w/ and /j/, nasals /m/ and /n/and the precedence of fricative /f/ over /s/. Linear development showing later mastery also includes /g/, /r/and /ŋ/. There were slightly fewer phonemes from age four onward in the mastery inventories than in the acquisition inventories, as would be expected with this more stringent criterion. The reasons for a phoneme consistently appearing early or later may not be explained only by the earliest phonemes being those that are the least marked universally. Equally those phonemes which are consistently late, may not just be demonstrating faithfulness constraints, whereby the child is responding to the models of the ambient language. Variations from the universal patterns may be due to factors such as their frequency in the sampled target words, or to the age and stage at which exposure to creole forms begins to impact phonological use. We will explore these reasons below when we discuss the data impacting our conclusions regarding the importance of universal patterns.

Examining linear developments that were apparent, but in percentages less than 75%, some patterns are nevertheless of interest to illustrate the possible impact of substrates. The differences between syllabic distributions of phones between age-groups were apparent in phones occurring with lower percentages. The SFWF /r/ showed a trend to increase with age, with 47% of 4-year-olds, 35% of 5-year-olds and 50% of 6-year-olds demonstrating its use. Mihalic refers to local speakers' use of SFWF /r/ but does not describe it as a rule, rather indicating that SFWF /r/ use depends on whether each word is derived from either German or the

substrate 'Tinata Tuna' (Mihalic, 1989, p. 8). This suggests that traditional SFWF /r/ usage depended on each word's origins, and whether the phonotactics of that language includes SFWF /r/. In our group, we could hypothesise a stylistic choice associated with some words. For example, all 20 of our 5-year-olds used SFWF /r/ in the word /kaɾ/, 'car'. This type of implicit variation discourages application of dogmatic phonotactic or phonological rules in this population. Certainly, more detailed study of phonological patterns and phonetic contexts is required before it is possible.

Some minor fluctuations gave testimony to the diversity of phonological progression within each age group cohort, but nevertheless did not undermine the basic increase of phonological skills with age seen in both the 75% acquisition inventory and the 90% mastery inventory.

Non-linear exceptions to the general progression with age at the 75% acquired criterion included SIWI /s/ acquired at four years then absent at five years before it reappeared in the 6-year-old group. The 75% inventory also saw SFWF /t/ acquired by the 5-year-old cohort, subsequently missing in the 6-year-olds.

Examples of non-linear development in the 90% mastery criteria inventories, were the SIWW /ʤ/ mastered by the 3-year-olds and then missing in the 4-year-old inventory. The SFWF /l/ mastered by 90% of f4-year-olds was missing in the 90% inventory of the 5-year-olds and 6-year-olds. Hua and Dodd note that many phonological studies have observed such apparent 'regression' (Hua & Dodd, 2006b, p. 18) in both individuals and groups, which can sometimes be overcome by longitudinal studies, but

not always. The influence of larger sample sizes and more homogenous language use and educational backgrounds may also clarify such apparent regressions.

Examination of the important Early, Middle and Late categories of sounds (McLeod & Crowe, 2018) as depicted in Figure 3 (Sander, 1972) in chapter six allows a clearer assessment of cross-linguistic similarities and differences. It is of interest to contrast Sander's original graphical depiction of customary production of English phonemes (50% of an age-group) up to mastery (90% of the age group), with the age ranges for TP phonological mastery for the same consonants. The consonants with the greatest interval between customary production and mastery in TP were /r, v/ (47 months), /ŋ/ (38 months), /g/ (37 months), /j/ (28 months), /s/ (26 months) and /ʧ/ (22 months). Sander's graph also depicts slow movement from customary production to mastery for /r/, /j/, /ŋ/, /v/ /s/ and /ʧ/. The similarity is striking, the only difference is with /g/, which is a phoneme with different phonotactics to English /g/. The differences are of interest, the 26 months taken by TP children to master /s/ contrasts to the English time period of 60 months. The slow development of /g/ in TP may relate to the position of voiced consonants in TP. They are prohibited in coda positions, but creole TP speakers can voice final velar plosive /g/, which our results show was a tendency that was strongest in the older children. The voiced affricate /ʤ/ is mastered over a 36 month period in Sander's depiction of English children's development, but in TP this period was reduced to five months. The phoneme was established in our group by widely used loanword templates

in which the phoneme's use is well established, showing the power of this creolisation mechanism. However, it is very likely to be a word specific phenomenon and requires deeper research.

The increase of phonological inventories with age was supported by the statistical analysis of mean PCC scores with the strongest differences existing between the 3-year-old PCC scores and all other groups. This leads us to conclude in answer to Question two that phonological inventories increase with age. The mean PCC climbed steadily with each age group, but variation within each of the groups, leading to extensive overlaps in range, reflects diversity in acquisition patterns in this population.

7.3 Phonological Processes and Age

Question three asked if developmental phonological processes declined with age. It was found that the occurrence of phonological processes declined with age both for structural processes such as cluster reduction and segment-based processes. The latter dropped from a total of 51 occurrences in the 3-year-olds to 10 in the 5-year-old group. The only process that did not decline steadily with age was fricatisation which rose in the 5-year-old group before declining in the 6-year-old group.

Some that were not seen five times, but which were seen more than once in a child's phonetic inventory (Gangji et al., 2015; Mahura & Pascoe, 2016; Maphalala et al., 2014), were the syllable structure processes *epenthetic vowel insertion* and *syllable deletion*. An example of epenthetic vowel insertion was /dolawara/, for /solwara/, ‘sea’ (participant 1). Syllable deletion was seen in the reduction of /banana/ to /ba:na/, ‘banana’

(participant 2). Vowel deletion was seen more than once in 36 participants, with 17 in the 6-year-old group alone. Vowel deletion could be attributed to processes related to creole abbreviation.

Pre-nasalisation of stops was seen more than once in eight participants and de-voicing more than once in 34 participants. However, all the occurrences of processes require further research considering the other influences on these multilingual creole speakers.

7.4 Phonological Processes and Universal Patterns.

Question four asks if universal principles are seen in the types of processes used. The syllable and word-based processes in this population; segment deletions and cluster reduction, are all processes seen universally. Amongst the substitution processes seen, the high number of voicing or aspiration changes (45 participants) show no clear pattern and may reflect that the default unaspirated TP plosives are now being joined by aspirated and voiced English plosives. Sometimes this is in the coda position, which TP phonotactic rules forbids, as the influence of English increases. The two next largest groups are fricatisation (11 participants) and lateralisation (14 participants) which are largely due to the wide use of the alveolar lateral fricative [ɬ] as a substitution for fricatives and laterals. As mentioned earlier, this is almost certainly due to the influence of the substrate language, Melpa.

Other processes seen in smaller numbers, such as stopping of fricatives, are universally familiar. Nevertheless, the developmental processes seen in this population show language specific influences more

clearly than universal pressures. Language specific causes may be either the phonological rules of TP or the ongoing creolisation process in this population.

An example is seen in the older children's use of the process of vowel deletion. Some examples, which could be creolisations influenced by English, were seen in 5-year-olds such as participant 75. TP /femili/, ‘family’ was produced as /femli/ and /onɪjon/ ‘onion’ as /onjon/. Vowel deletions such as reducing /sɪkarapɪm/, ‘scrape’ to /sɪkrapim/ and /bɪlas/, ‘decoration’ to /blas/ (participant 76) may be creole morphemic condensations. These have been observed in older children and adults as creole morphophonemic condensations (Romaine, 1992; Smith, 2002). Amongst the 5-year-old group, of the six children who produced 'bilas' as /blas/, all were able to produce the similar word 'balus' with complete articulatory accuracy. Simplification by six participants in the 5-year old group of the four syllable word 'sikarapim' with a vowel deletion to produce /sɪkɾapɪm/ also may not have been due to universal motor constraints. Only one of the six children who deleted the vowel in 'sikarapim' couldn't articulate the three syllable word 'kakaruk without any articulatory change. Such examples are not English borrowings, or clearly due to articulatory limitations, but may rather reflect the creole morphological condensation described in earlier TP studies (Romaine, 1992; Smith, 2002).

The youngest children's earlier approximations are in terms of both articulatory phonetics and phonological trials. Some apparent misarticulations, such as the widespread use of [ɬ], may be due to

phonological interference from the other languages they have or are simultaneously learning. They may be applying the rules of other languages, using shared phonemes differently (Yang & Hua, 2010), or they may be using similar phones from another language incorrectly. In a study of children acquiring African American English (AAE) speech, Bland-Stewart concludes:

'AAE phonological patterns may be evident as early as 2 years of age and are aspects of the child's evolving dialect rather than being indicative of pathology (2003, p. 119).' .

Just as mature AAE speakers master standard American English, but show the impact of their AAE dialect earlier, a TP speaker may have mastered their local TP dialect by age six, but phonological processes seen at earlier ages may reflect their other languages.

7.5 Usage Based Sociophonetics

Sociophonetics is a discipline integrating phonetics and sociolinguistics and addresses 'questions in sociolinguistics with reference to phonetic variables' (Foulkes, Scobbie, & Watt, 2010, p. 703)

In multilingual child phonological acquisition, Dodd and Hua point to both interaction between the two language systems and the characteristics of the ambient language (2006a). An important mechanism of phonetic and phonological change, which we also observed in this population, is loanword adoption (Docherty & Khattab, 2008). The impact of word templates on children’s phonological learning was a factor in both segments acquired differently from the expected sequence and in the processes

employed. An example is the expanding use of voiced labio-dental fricative /v/ in this population. It owes much to its presence in the word /draiva/, 'driver' which was readily elicited and confidently articulated in this SIWW position. It was elicited in 100% of participants and there were only three instances of errors among the 80 participants. Less common is the SFWF /v/ which could occur in two of our target words; /faiv/,'five' and the loanword /daiv/, 'dive'. The word 'daiv' is a local usage, children say this rather than /waswas/, 'swim'. 'Faiv' and 'daiv' are borrowings that were frequently de-voiced in SFWF. This is in keeping with TP distribution rules, which only allow voiceless phonemes in SFWF positions. However, this example of TP coda devoicing showed a progressive decline with age, and it could be argued, exposure to English, with nine instances in the three-year-old group, 12 in the 4-year-olds, seven in the 5-year-olds and just two in the 6-year-olds. Over all participants, 68% successfully used SFWF /v/, but the 6-year-old group had 84%. Sociolinguistic choices may be influencing the phonetic content of older children with longer exposure to English forms. Another example is the use of /ʤ/. The popularity of ginger in the local diet, and the frequent adoption of the English label and phonology, may equally account for early mastery of SIWI and SIWW /ʤ/.

Interaction between the language systems in this environment is also apparent in the shift over time from 3-year-olds lack of SFWF voiced plosives and fricatives to the 5-year-olds' mastery of SFWF /g/, seen in the adoption of the English forms for /dok/ 'dog' and /pik/, 'pig'. Thus, the interaction between word templates and phonology, as has been observed in

other studies (Kehoe, 2011; Stoel-Gammon, 2011; Vihman & Keren-Portnoy, 2011), are part of phonological change in the TP creolisation process.

7.6 Universal Features of Segment Acquisition.

The Structuralist, Universal Grammar and Natural Phonology schools all look for universal features in segment acquisition. This search will include the precedence of unmarked consonants (Hecht & Mulford, 1982) and the unmarked features that distinguish those consonants (De Lacy, 2006). Use of unmarked features is described by Optimality theory as adherence to markedness constraints (Jusczyk, Smolensky, & Allocco, 2002). Markedness constraints are counterbalanced in the developing child by faithfulness constraints (D A Dinnsen & O'Connor, 2001) that seek to be faithful to the inputs of the adult model in the child's environment. This study's fourth question examines the presence of universal features in terms of precedence given to unmarked consonants in the children's phonological inventories. Examining the gradual acquisition of phonemes in this population, we see the impact of both markedness and faithfulness constraints.

We will now compare 3-year-old group's phonological mastery inventories in the current study in light of the precedence of unmarked segments in young children as described by Jakobson (1968), whose work is foundational to each of the schools mentioned. Phonological studies subsequent to the beginnings of Jakobson's Structuralist theory vary so that comparisons are difficult. We will therefore limit comparison to two more

recent reviews of cross-linguistic developmental studies (Hua & Dodd, 2006c; McLeod & Crowe, 2018). These variations between studies include both the age ranges studied, the criterion of the number of syllabic positions required and the percentage of an age group that indicates phonological mastery (McLeod & Crowe, 2018). Jakobson did not give a percentage criterion for mastery. The current study has data from three years onwards, and it is possible that some of the phonemes mastered by the end of the third year may have been mastered earlier.

The early speech of children starts with minimal contrasts according to Jakobson. After the vowel/consonant contrast, the earliest sounds are thought to be /p, t, m, n/ (Jakobson, 1968; Macken & Ferguson, 1981). A recent cross-linguistic survey of the results of phonological research in 27 languages listed a large group of sounds mastered by the end of the third year. These are /p, b, t, d, k, g, f, v, h, w, j, m, n, ŋ/ (McLeod & Crowe, 2018). These match Jakobson's' earliest four, with additions which are all phonemes from the TP phonology.

One of Jakobson’s claims was that these earliest phonemes would not fail to be contrastive in any of the world’s languages (Meade, 2006). The early phonemes mastered, (90% of age band), by the 3-year-old group of this present study were the plosives /t, d, k/, fricative /f/, approximants /w, j/ and the nasals /m, n/. These are all included in McLeod and Crowe's cross-linguistic survey results (2018), but are slightly different to Jakobson's list. The 3-year-old group had acquired (75% of group) contrastive use of Jakobson’s four sounds. However, the 90% criterion of mastery lacked the

/p/ phoneme which was limited to the onset syllabic positions SIWI and SIWW and coda SFWF. However, many studies only required one or two syllabic positions (McLeod & Crowe, 2018). Contrastive use of /p/ was not mastered by this population in all possible positions until the 5-year-old group, but two positions were seen in 90% of both the 3-year-old and 4-year-old age groups so this result is comparable to the data in Mcleod and Crowe's review (McLeod & Crowe, 2018).

Hua and Dodd's summary of phonological acquisition of eight monolingual and six bilingual language groups includes eight phonemes;/m, n, p, b, t, d, k, g/ amongst the earliest sounds cross-linguistically (2006c). However, the variations in acquisition criteria between these studies again make comparison difficult. The 3-year-old group's phonological inventories in this present study show a nearly identical group of phonemes to Hua and Dodd's eight, in all positions at the 75% of group criteria, with the addition of the /f/, /j/ and /ŋ/ and the absence of /g/. At the 90% mastery criterion, the 3-year-old inventory matched Hua and Dodd's group of phonemes with the addition of fricative /f/, approximants /j, w/ and the absence of plosive /g/.

Compilations of English, Japanese, Korean and Spanish developmental studies (McLeod & Crowe, 2018) and Hua and Dodd's summary (2006c, p. 436) of six different bilingual pairs of languages, all included /p/ amongst the earliest sounds mastered using the 90% criterion in five of the six studies and the 75% criterion for one study. In this present study the /p/ was acquired but not mastered by both the 3-year-old group (75%) and the 4-year-old group (85%). However, the only syllabic position

lacking in the mastery of /p/ was SFWF and the TP phonological measurement totalled across all syllabic positions shows early mastery of /p/.

In summary, apart from /p/, our youngest participants had acquired all the earliest sounds described by Jakobson in every possible position. Current cross-linguistic studies include sounds not present in the TP phonology but for phones they have in common, there is strong consensus between our study and current cross-linguistic reviews of phonological development.

Jakobson suggests that plosive consonants would take precedence over nasal consonants, with fricatives next, followed by liquids. McLeod and Crowe's cross-linguistic survey (2018) found most plosives and nasals were mastered before 48 months. This present study does not have data on younger children, but our 3-year-old group had mastered consonants in all the manners of articulation. The percentage of children having acquired nasals (66%) was higher than that those who acquired plosives (50%). Early phonemes in TP included /j/ which was mastered at age three and /l/ by age four, which is in keeping with the results of McLeod and Crowe's cross-linguistic survey. The TP mastery of the affricate /ʤ/ by 43 months is earlier than most English speakers but in keeping with cross-linguistic summation of 27 languages (McLeod & Crowe, 2018). Late phonemes in our results were /r/ and /s/ in keeping with other studies (Hua & Dodd, 2006c; McLeod & Crowe, 2018). TP children mastered the /r/ phoneme late in development,

in fact it was not acquired (75% of age group) or mastered (90%) by six years.

Voiceless consonants were predicted to take precedence over voiced consonants in the Jakobsonian framework (Macken & Ferguson, 1981). In our population, the voiceless consonants /t, k, f/ were mastered by the3-year-old group. The group of earliest sounds mastered in all positions did however include the voiced plosive /d/, and /v/ was mastered in all but the SFWF position. This /v/ usage is faithful to the TP phonotactic rules which preclude final voiced consonants.

Tok Pisin distribution rules prohibiting final voiced phonemes were not always observed in our population. When SFWF /g/ was a possible target, it was present in the 6 year old group, showing a stronger adherence by older children to newer creole patterns borrowed from the lexifier language; English. There was a change with age from 3-year-olds lack of SFWF voiced plosives and fricatives to the 5-year-olds' mastery of SFWF /g/, seen in the adoption of the English forms for /dok/ 'dog' and /pik/, 'pig'. Within the target phonology, only plosives and fricatives distinguish between voiced and voiceless. In summary; this group's voiced and voiceless usage from age three onwards, owes more to faithfulness to the ambient language models than universal markedness constraints.

The final universal pattern suggested front sounds will take precedence over back sounds (Jakobson, 1968). The inventory of acquired sounds correct in all possible positions in this group of 3-year-olds includes the back sounds /k/ and /j/ as well as front sounds /p, d, f, w, m, n./. There is

an interaction between place and manner, with /k/ and /j/ both belonging to groups defined by manner of articulation acquired earlier and are consistent with many cross linguistic studies (McLeod & Crowe, 2018). The unvoiced glottal fricative /h/ is not used contrastively with any consistency in TP, and this population was faithful to this TP pattern.

In summary, this dataset gives some support to Jakobson's claims for the precedence of voiceless, front sounds, but the earliest inventories also include voiced front sounds /m, n, d/ and back sounds /j, k/. Voicing of SFWF voiceless plosives was seen in this population. Thus, this cohort shows adherence both to faithfulness constraints and markedness constraints with interaction in the data between place, manner and voicing.

7.6.1. TP and other creole phonologies. There are differences between TP as a creolising language and established creoles elsewhere. Looking specifically at creole language acquisition, two cross-sectional studies of consonant acquisition in Jamaican and Haitian creoles (Archer, 2013; Archer, Champion, Tyrone, & Walters, 2018; Meade, 2006) have recently been completed and are a point of reference for creole languages. Their inventories shared considerable similarities to other language consonant inventories (McLeod & Crowe, 2018). Both the Jamaican and Haitian creoles are strongly in contact with their lexifier languages (English and French respectively) and can be described as part of a continuum. Both the phonological inventories of Jamaican creole and Haitian creole, are larger than in TP when in their acrolect forms, which are closest to their lexifier language (Archer, 2013; Meade, 2006). The TP group had smaller

inventories at each developmental stage. Haitian and Jamaican inventories were slightly larger than 75% of the TP-speaking children, because they include emerging lexifier fricatives like the post alveolar voiced fricative /ʒ/. One explanation may be that sociolinguistic factors such the sociolect and level of contact with the lexifier language can impact the phonological inventory of a creole. Studies of TP limited to acrolect populations, which are a small percentage of PNG TP users, may show similar results to those in the Haitian and Jamaican creoles.

7.7 Impact of Gender

The fifth question in this study asked if there is a difference in the way boys and girls acquire their phonologies. Very little is available to establish whether gender is universally a factor in consonant acquisition, but developmental studies which address gender generally find no difference in acquisition patterns (Coloma et al., 2010; Crystal, 1987; McIntosh & Dodd, 2008)(Coloma et al., 2010; Crystal, 2003; McIntosh & Dodd, 2008). A small difference was found in the mean consonants of young Arabic speakers with boys showing slightly larger phonetic inventories (Amayreh & Dyson, 2000). Despite some minor differences showing boys in our younger age groups having slightly higher mean PCC than the girls, this study confirms that there is no statistical difference between girls and boys in the development of phonology. Further study on the impact of socialisation and phonological acquisition would be of interest.

7.8 Impact of Sociolinguistic and Cultural Setting on Research Method

Hua and Dodd's call for comparable criteria in developmental phonological research is appropriate if valid comparisons are to be made cross-linguistically, and between multilingual and monolingual acquisition patterns (Hua & Dodd, 2006b). However, it may be that the stringent criteria used in well-researched languages such as English and the Indo-European group of languages, may be usefully supplemented by criteria which show the details of development needed in a pioneer research, multilingual setting. Less stringent age group percentage criteria for phonetic and phonological inventories are more able to detect the youngest children's ranking and re-ranking of hierarchies as they acquire the various phonetic and phonological features of their multiple languages subsets (Broersma & De Bot, 2006; De Bot, 2004; Silva & Rodrigues, 2015). In this present study's dataset, for example, the presence of fricatisation in the phonetic inventories of 35% of 3-year-olds, may indicate substrate impacts early in acquisition. All consonant clusters except /pl/ were limited to one opportunity in order to keep test length manageable and were not detectable by a criterion requiring more than one instance. The SIWW stop/lateral cluster /pl/ showed up in more than one occurrence in over 75% of children in each age group because of its frequent occurrence in SIWW position in 'pla' the common adjectival suffix. Even the most complex clusters which included one of the fricative /r/ clusters were seen once in 50% or more of children from three years onwards.

Employing a second criterion of percentage correct to indicate age group mastery of a phonological inventory has been used in some cross

linguistic studies (Amayreh & Dyson, 1998; McLeod & Crowe, 2018). Given that there are a range of criteria employed cross-linguistically for phonological processes (Hua & Dodd, 2006c), using an additional, less stringent criterion for phonetic inventories and phonological processes may be a valid strategy for exploring substrate vernacular and lexifier influence in studies of multilingual creole populations.

Syllabic positions were not a formal part of our criteria for phonological and phonetic inventories. Nevertheless, we summarised the segments that occurred in all permissible positions and obtained results for the four syllabic positions. The phonological inventories obtained were impacted according to how many syllabic positions were required to exhibit either the acquisition (75% age group) or mastery (90%) of a phoneme. When all available positions were part of the criterion, sounds such as the voiceless bilabial /p/ were excluded in the 3-year-old phonological inventory. When the percentage correct was totalled over all syllabic positions, which included two to three syllabic positions, the results were closer to those regarded as universally typical. This data was used to generate the graphical representation of acquisition in this present study (Figure 3). Although McIntosh and Dodd (2008) required a developmental process to occur in different lexical items to be considered a process, most studies were not so precise. Clinically, SLPs are encouraged to sample consonant use across all available syllabic positions (McLeod & Baker, 2014), but criteria for how many syllabic positions are required to indicate acquisition or mastery varies in cross-linguistic phonological development

studies. The most common requirement is for one position (McLeod & Crowe, 2018). In cross-linguistic studies, where phonotactic rules vary from language to language and the number of syllabic positions differ, it is difficult to establish comparable criteria for this aspect of acquisition.

Process analysis in this population is complicated by the fact that it may at times be difficult to determine which processes are developmental and which features are due to interference due to their multilingualism (Albrecht, 2017). Fricatisation is a feature of Melpa and several other highland languages (Mihalic, 1989). In addition, these children may be employing the phonological features of the languages involved in the creolisation of TP, with code-shifting and incorporation of loanwords (Meakins & O'Shannessy, 2016).

With limited exposure to books and media, children's vocabulary knowledge was limited to the local area experiences. Our dataset also contains examples of vocabulary knowledge impacting elicitation rates and error rates, so it is important to discover the local vocabulary for each group. For example, there were participants in each age group who found the word /solwara/, 'sea' difficult, with 15% of 3-year-olds and10% in the 5-year-old group showing the next highest percentage of difficulty. Children of the PNG Highlands don't see oceans and seas, or have exposure to literature, so it is very likely that this word was less familiar to young children who were just beginning their education. When shown photographs of the beach, they related them to the gravel beaches of their large Highlands rivers. A more predictable structural development was seen in the longer CVCVCVCV

word /pɪkɪnɪni/ which had 50% accuracy with the 3-year-old group. The current vocabulary of TP and local variations in both word-use and pronunciation require further study to support future developmental research.

Standard education in PNG, and with it exposure to English, begins at grade three. The family language-use survey information showed that there was a range in the inputs and outputs of the three language types both within and between age groups. The language use survey of this study asked the parents when their child began using TP, as well as the level of TP language use in the home (Appendix J). This language survey rated each family group on a four point nominal scale and revealed a variation in exposure to each of the three languages (Appendix J, Figure J1); TP, English and Melpa. The variations in children's inputs and outputs impacts their developing phonological categories, perception and memory (Kehoe, 2011; Stoel-Gammon, 2011; Vihman & Keren-Portnoy, 2011). Some aspects of this variation impacting children in this study were diversity between participants of the same age in establishment of their 'mental lexicon' (Stoel-Gammon, 2010, p. 2), which comes with vocabulary acquisition in the target language. Differences in vocabulary were apparent in the differences we saw in elicitation rates for the target words, even within the same age group. This in turn impacts the levels of phonological mastery, and the impact of variant word forms on phonological learning.

Some words were not established in younger children's vocabularies and required modelling by the research assistant during data collection.

Younger children required more Tokples support during administration and more prompts and models. The mean rate of spontaneous elicitation of the 67 target words ranged from 50% in the youngest six month cohort (36-41 months) to 82% in the oldest cohort (78-83 months). New words may vary in status from nonce borrowings to full adoption by the language group (Matras, 2009).

The role of word templates may be the cause of the expansion of /ʤ/ distribution, in this case /ʤ/ in syllabic positions other than SIWI. It appears in the recent loanwords /ʤɪnʤa/, 'ginger', /ʤizas/, ‘Jesus’ and is also chosen by highlanders to represent the fricative in the new loanword/ʤɪpa/, 'zipper'. It appeared in both SIWI and SIWW positions in the 4, 5 and 6-year-old groups. The word /klaut/, 'cloud' is an established loanword. This population did not follow the TP phonotactic restriction on final voiced plosives, with 99% of the children pronouncing it as /klaud/. There may be other words where the SFWF /t/ is still /t/, which means they need to be found in order to adequately assess SFWF /t/. Loanwords can reveal creolisation at work in the language and it is necessary that word targets are fully researched so that usage and phonetic forms are fully understood. Variant word forms such as those observed in this study may persist for extended periods in a creolising, unstandardised language like TP, and may need accommodation in any tasks employed to measure phonology.

7.9 Limitations

Research goals can be more specific with homogenous populations, but homogenous populations are difficult to find in multilingual settings.

Ensuring a homogenous sample in a multilingual study inevitably reduces the number of available participants (Fabiano-Smith & Goldstein, 2010b), which reduces the ability to generalise results. The impact of the variability in language use and educational background which we observed in this population was evident in this data. There was variation in parental education background and participants who were from a community setting, rather than from a pre-school, often had no pre-school experience and ages of entry to elementary school varied. This present study obtained limited language use data which showed variation in exposure to the written word and media. Extremely careful description of language use is an important part of valid comparisons, especially in multilingual settings (Paradis & Jia, 2017), and this is an area that should be explored further in future research. The area of language use is so important, but also so complex that it would require a specific study dedicated to investigating language use in enough detail that also accommodates cultural limitations to written surveys in this setting. Some strategies used elsewhere, such as parental diaries of daily language use (Fabiano-Smith & Goldstein, 2010b), may not be applicable in this population of mixed literacy levels.

The preliminary nature of a phonological study in a language with limited standardisation meant that the source of data supporting the creation of tools was limited. The internal validity both of the word naming task and the questionnaires could be improved with further specific research to contribute appropriate language resources. There have not yet been any studies specifically highlighting children's vocabulary acquisition in TP and

there are virtually no familiar picture books. Knowledge of vocabulary items at different age groups would allow a more refined choice of word targets. It is ideal to elicit target phonemes in multiple words for each appropriate syllabic position (McLeod & Crowe, 2018), which was not possible for every target in this study. The smaller vocabulary of TP makes this a challenge.

The challenge of identifying targets to allow for multiple opportunities for elicitation of each phoneme in each legal position may also have contributed to acquisition patterns. TP vocabularies, as is usual with pidgin and creole languages, are smaller than other languages (Velupillai, 2015). If we add the limited vocabularies of young multilinguals it is challenging to devise a word naming task that gives these multiple opportunities regardless of functional load (Hua & Dodd, 2006b). Reporting of accuracy by syllabic position can vary between studies and is somewhat dependent on what the language allows (McLeod & Crowe, 2018). Voiceless plosive /t/, for example, was not in the group of sounds acquired in all syllabic positions, being absent in SFWF position where it was targeted three times. However, when assessed over the total of all syllabic positions, it is shown to be acquired early and rapidly. Therefore, support within this data for precedence in acquisition of unmarked sounds is dependent on both how many syllabic positions are considered and how many opportunities there are in each position.

The phonetic inventories were shaped by their defining criteria, which were chosen to align with internationally comparable criteria. It is

important that comparative criteria are used in multilingual studies (Hua & Dodd, 2006b). However, when word naming tasks are the source of the data, and phones are examined in the maximum number of syllabic positions, it can be difficult to find suitable vocabulary to sample every syllabic position exhaustively. There may be times when, with younger participants, the results outside the set criteria will also yield data of interest as was seen in the frequency of [ɬ] and the constant clusters which could be observed only once but appeared in over 50% of each age group.

This study was limited in its access to technological support. The poor recording conditions in small pre-schools and community settings study underlined the need for the best possible external microphone worn by the participants when collecting phonological data. Phonetic transcription of the data relied on the perception of the researcher and team. The accuracy was limited by lack of access to acoustic analysis, which, with appropriate phonological analysis software (Byun & Rose, 2016; Oller & Delgado, 2000), would have expedited the process with this number of participants and reduced the possibility of human error. Future preparation of an electronic phonological software analysis package for the TP language would be of value.

This was a preliminary study which, despite being somewhat larger than many cross-sectional developmental studies in new languages (Ballard & Farao, 2008; Gangji et al., 2015; Mahura & Pascoe, 2016; Maphalala et al., 2014), is still of moderate size in comparison to many monolingual studies (Ceron, Gubiani, de Oliveira, & Keske-Soares, 2017a; Da Silva et

al., 2012; B Dodd et al., 2006; Hua & Dodd, 2000). Larger group sizes would give more power to statistical analyses and improve external validity. However, there is also the risk that a larger sample would be equally or even more heterogeneous. Our largest language-use group, group three 'Mixed Melpa and TP, English TV' (51.25%) was also the group with the most outliers in its PCC results. The only statistically significant difference was between the PCC of the 3-year-old group and each of the other three age groups. This may indicate the benefit of larger group samples to allow more power. A larger sample would also allow for examination of smaller age range groups within the 2 to 4year-old age range to identify the earliest acquisition patterns.

The study is limited in that it examined only consonants. Although consonants are an excellent focus for a first study, full consideration of phonetic and phonological development requires examination of vowel development. This may also require sampling of a younger age cohort as vowel development is generally established earlier than that of consonants (Hua & Dodd, 2000, 2006a).

Given the large number of languages spoken in PNG we cannot be sure of the extent to which the findings of this present study could be generalised with any validity to TP spoken by groups with different substrate phonologies.

7.10 Clinical applications.

This study has provided valuable data for future PNG clinicians who must decide when support is appropriate. The complex linguistic setting of

TP phonological acquisition has clinical implications. The variation in inventories is evident within as well as between age-groups and shows that acquisition is not always linear. The results obtained indicate the importance for the clinician of considering the various language inputs influencing each child's phonological acquisition developmentally. This is also useful data for educational settings, where linguistic complexity will also influence the phonological awareness which supports children's literacy acquisition. The PNG education department now supports the use of phonics in literacy education, and future phonological development data will be of value to teachers as they implement this policy. Teachers can also be supported as they assist children to understand and compare the different phonics of their multiple languages. Children showed a wide range of ages of acquisition for all but the earliest and least marked phonemes. The results showed children drawing on the resources of other phonological inputs. This resulted in both earlier acquisition of some sounds, such as affricate /ʤ/, and the interference of phonologies outside TP. This developmental data supports the theoretical proposition that the child's task of differentiating which phoneme is appropriate to which phonological inventory subset, is a more complex process in a multilingual setting. This is further complicated when the phonology belongs to a variable, creolising language.

The emerging contrast between /f/ and /p/ as seen in /f/ target word accuracy for over 85% or greater, for all syllabic positions in all age groups, and the emergence of new sounds in loanwords such as SIWW/ʧ/, in /tiʧa/, 'teacher' and SFWF /v/ in ‘faiv’ provide evidence that TP phonology is

evolving, so there is a need to be aware of and observe local patterns. The ages considered appropriate for acquisition of each feature and segment must be regarded as a range rather than a deadline, and emerging phonemes like /ʧ/ and /z/ should not be treated as errors. The clinician must be aware of the need to differentiate between the impact of delay and creolisation in the phonology.

When multiple phonologies are in play, there is also a difference between language use in different languages and actual phonological skills. TP speakers who are multilingual, have in theory, the phonologies of their other languages available to them (Smith, 2002). Other language phonologies may be available but not always used; for example, /z/ can be imitated, but is often not used, except in appropriate loan words like /jizas/, 'Jesus'. Phonetic skills are greater than TP phonological inventory suggests. For all these reasons, a graphical representation such as a Sander-style table which shows the time elapsed between customary acquisition and mastery of phonemes, will be a valuable clinical tool illustrating the range of ages within which a segment can be expected to develop. The Early, Middle and Late (EML) phoneme categories are important, highlighting groups of sounds and their acquisition patterns. These have been shown to vary between languages (Fabiano-Smith & Goldstein, 2010a; McLeod & Crowe, 2018; Shriberg, 1993), so it is important to identify EML phonemes for each language group and multilingual setting. In TP, for example, the clinician must expect late acquisition of /r/ and /ŋ/ and a large range of ages for

acquisition of /s/, the voiced plosive /g/ and the presence of emerging segments such as /z/ and /ʧ/.

There are also acquisition patterns which are specific to TP. The lack of contrastive use of /h/ in TP means it is used but doesn't feature in a phonological inventory. The process impacting /r/ acquisition is liquid confusion, resulting in substitution of /l/ for /r/ in children who have not yet acquired the articulatory skills required for the tap, flap or approximant /r/.

Similarly, the analysis of processes yields valuable information about language-specific acquisition patterns in this population. The high numbers of developmental processes in the 3-year-old group is expected but the causes are not exclusively physiological or sensory. Whilst there are processes with clearly developmental origins, such as de-affrication and fronting, cross-linguistic interference is seen in high levels of processes like fricatisation and lateralisation. The latter show a level of uncertainty about the TP phonological targets amongst the youngest children. There is interference from both the substrate and newly discovered English phonology that they do have full control of yet. By contrast the 5-year olds' use of the trill or flap for coda /r/sits easily with their complex clusters containing /r/ and the /r/ use elsewhere in the word structure. Thus, when assessing children's articulatory skills, the collection of phonetic inventories must never be limited to a set of target phones but should be as sensitive as possible to identify input from substrates.

7.10.1 Importance of word templates in phonological learning.

TP phonotactic development seen in this present study confirms the

importance of word templates in phonotactic development, and of the value of multisyllabic words to highlight developmental articulatory difficulties. Children's phonological development may be assisted by exposure to appropriate new lexical items.

The power of new word templates was confirmed in the child data when templates were shown to expand the distribution of the phonetic repertoires of the children. The introduction of new phonemes or new distribution of phonemes was first seen in the adult pilot study with frequent code-switches including elements of English phonology adopted to different degrees (Matras, 2009; Matras & Sakel, 2007). These were sometimes clearly code shifts that maintained both the donor word structure and phonology, but at other times donor phonology within TP structure. These introductions are part of children's language models that were subsequently noted in children's production of phonemes. Linguistic studies would be required to fully test the incorporation of such new phonetic usage into the phonology as contrastive in the new syllabic positions. Because of the power of word templates, clinicians assisting phonological development in children may find assisting vocabulary development a valuable tool.

7.11 Future directions

Many of the limitations of this preliminary study could be remedied by further research, some of which have already been alluded to. This study has provided an initial guide to the phonological acquisition of Highlands TP speakers, identifying the EML categories of consonant acquisition. Further studies may explore this area further and also seek to provide

similar data for a wider range of TP sociolects within PNG and more in-depth analyses of the TP phonological development. The expansion of TP phonological studies would benefit from the preparation of the software for electronic analyses of TP using phonological software.

Each research method has advantages and disadvantages in developmental studies. Most developmental phonological studies are cross-sectional studies (McLeod & Crowe, 2018). The possible value of longitudinal developmental small studies, or combining longitudinal and cross-sectional studies highlighting language use (Meade, 2006) could profitably be explored**.** For example, study of Turkish/German bilingual children's phonological development combined an original cross-sectional study of 84 children with a follow-up study of 43 participants (K. M Albrecht, 2017).

Further work refining the word list of the naming task to improve spontaneous elicitation would contribute to internal validity and provide resources for clinical treatment tools. This would involve both understanding the vocabulary and age of acquisition of vocabulary items and testing culturally appropriate elicitation techniques such as indirect modelling (Prater & Swift, 1982, p. 396) and practice items (Carter et al., 2005). Children's vocabularies will also change as television and other media continue to penetrate further into the community, and this could be monitored.

Other sampling formats may also be worthy of exploration as understanding the phonology is improved with a variety of data collection

formats (McLeod & Crowe, 2018). This study used a single word picture naming task. This type of task has inherent limitations in terms of the number of times phonemes are sampled. Word naming tasks have the advantages of allowing pre-planned comprehensive testing, predictability and glossing (Chen, Bernhardt, & Stemberger, 2016) which we have outlined earlier. However, future use of semi-structured story sequence tasks or some form of delayed imitation such as re-tell tasks may allow elicitation of more word types than the nouns and adjectives which dominated the word-naming task used. Combination of sets of core words with supplementary word targets may allow reduction of test length (Chen, Bernhardt, & Stemberger, 2016).

Different levels of phonological mastery may need to be investigated using phonological scaffolding (Glaspey & Stoel-Gammon, 2005) in order to gain the full picture of children's phonological skills. Additional receptive tasks could inform children's contrastive use of phoneme pairs such as /f/ and /p/ with questions such " is this a …?" However, the limited number of minimal pairs in children's TP vocabularies would make such a task challenging. Further cultural investigation would also be needed to support alternative task structures. The reserve of highlander children, particularly girls, and their resistance to verbal performance, meant that, for this study, picture-naming was the least demanding option.

Spontaneous conversational sampling techniques, whilst potentially demonstrating a comprehensive range of phonological contexts, would require considerable time helping the child to relax as well as software

supports to transcribe and analyse connected speech. Analysis of spontaneous speech samples is only feasible if a software programs such as PHON or LIPP have been prepared for TP analysis. This would expand the range of both independent and relational analyses possible (Byun & Rose, 2016; Gildersleeve-Neumann & Wright, 2010; Oller & Delgado, 2000). Software can also speed analyses and allow larger samples of the population. More detailed information could be obtained, for example, with studies analysing not just syllabic inventories but the detail regarding the impact of phonetic environment such as intervocalic versus onset and coda positions. Studies supported by acoustic analysis would also help to clarify the impact of different phonologies during children's acquisition of TP. Production of an ideal sampling tool is likely to require specific targeted studies (Abou-Elsaad, Baz, & El-Banna, 2009). Preparation of the electronic analysis software for TP would be a valuable addition to future research.

Three types of multilingual acquisition are described in the literature: Bi- or multi-lingual from birth, simultaneous multilingualism and sequential multilingualism. Simultaneous bilinguals are defined as children who are exposed to the next language before age three, and sequential bilinguals as after three, ‘after fundamental language learning has occurred’ (Gildersleeve-Neumann & Wright, 2010, p. 430). It is likely that the language inputs and output opportunities of children impact their acquisition of what, for the children who are successive bilinguals, is a new phonology.

A definitive assessment of which category of multilingualism into which the children in a study fall, would allow an assessment of relative

language dominance (Liu-Shea, 2011). In turn, this allows more specific description of the relative influence of the different languages being acquired in phonological development, the impact of shared and unshared sounds (Fabiano-Smith & Barlow, 2010; Fabiano-Smith & Goldstein, 2010b) and identification of the markers of under-differentiation of phonologies which can be a sign of phonological disorder in such populations (Liu-Shea, 2011).

Future studies would benefit from a careful focus on children's history of language exposure so that the age of second language learning can be clarified. It is likely that the language inputs and output opportunities of children impact their acquisition of what, for the children who are successive bilinguals, is a new phonology. This should include data on the education and language use of mothers, aunts, female siblings and grandmothers as the primary care-givers and language models. The role of fathers and peers in language exposure also requires careful identification. PNG has high levels of passive bilingualism, so both children's exposure to other languages, and the age when they begin to use them is important. Because of cultural prohibitions on information sharing, ethnographic studies of family structure (Kuo & Anderson, 2012) and information sharing as well as language use in sequential multilingual practices in PNG would be of great value. Accurate data on language use is essential in studying the phonological acquisition of multilingual children (Ballard & Farao, 2008; O'Shannessy, 2015; Peukert, 2015). The language-use and family education questionnaires would benefit from research to gain a better understanding of

cultural attitudes to sharing personal information and culturally acceptable methods of obtaining such information. Developing questionnaires with a level of validity that allow quantification of the impact of language use on phonological development is a complex task requiring future study. Better understanding of children's simultaneous and sequential multilingual status also allows clearer understanding of the expected benefits of multilingualism as children add their second and subsequent languages (Kuo & Anderson, 2012).

This study has highlighted a number of factors which relate to children's phonological acquisition which will impact literacy skills (De Sousa, Greenop, & Fry, 2010; Dixon, Chuang, & Quiroz, 2012; Fabiano-Smith & Hoffman, 2018). Interdisciplinary cooperation is crucial in the future development of SLP in PNG. The data obtained in this research will be a support for teachers learning how to teach literacy through phonics in PNG's multilingual setting. However, the complexity of the PNG linguistic situation also suggests SLPs in PNG will need to work closely with anthropologists and linguists for precise professional descriptors of factors impacting language acquisition and literacy.

This study has also contributed data about the specifics of creole language phonological acquisition in this sociolinguistically mixed population. Inventories are both smaller than acrolect forms but include the adoption of lexifier phonology and distribution rules through loanwords such as /ʤɪnʤa/. The degree to which such patterns are word-specific rather than integral to the phonology of TP requires future monitoring, as do the

specific impacts of English and the individual substrate phonologies such as Melpa and other substrate languages on local TP phonologies. Rumsey also observed that the stopping phonological process for [s] is a developmental pattern in Ku Waru (A Rumsey, Personal Communication 2.9.2020), just as it is in English and TP.

The database of TP phonological acquisition would profit from further studies in populations from other Tokples language backgrounds. As further child development studies are conducted in vernacular languages they will shed light on TP's influence on vernacular languages. The seminal work of Rumsey has shown how the phonological repertoires of children in the Ku Waru language have been influenced by TP. For example; the original three Ku Waru laterals have been joined by the apico-alveolar /l/ as a result of the influence of TP (Rumsey, 2017). Further child studies are also needed in more rural remote populations in contrast to urbanised settlement populations who use TP as their mother tongue more consistently and have a more varied substrate exposure. Urban speakers may continue to have the high level of phonetic diversity Smith observed in his adolescent participants (G. Smith, 2002), or they may have evolved a more settled TP phonology.

7.12 A Framework for Creole Studies.

Given the challenges in conducting phonological research in multilinguistic communities such as the Highlands of PNG, one strategy to consider is the development of a framework to guide such work. This study allows the opportunity to consider suitable frameworks for multilingual

studies, with an emphasis on the implications of working with a creolising language. Implementation of the study confirmed the value of each element of the study and also gave indications of adjustments which would serve such a community in future research. The steps in a suggested framework are outlined below. This framework would assist researchers to benefit from the work of those who have gone before them, and also facilitate consistency in studies. The following steps are those proposed for a Framework for Creole Studies:

7.12.1. Equip the clinical researcher with fieldwork skills. Ensure adequate phonetic transcription skills and equipment (Chelliah & Reuse, 2011; Himmelmann & Ladd, 2008).

7.12.2 Develop an understanding of the cultural context (Heath, 2008). Cultural context, the focus of anthropological expertise, is also critical for language researchers. Living and working in a culture is valuable for both understanding and local acceptance. Ethnographic tools (Heath, 2008; Merlan & Rumsey, 2015) as well as friendship and strategic community links are all important contributors to a valid language study. Carefully designed research tools should also reflect cultural understanding.

7.12.3 Native speaker assistants. Ideally, when conducting clinical phonological studies, it is preferable to recruit a locally trained researcher. When none exist, as is the case at this point in PNG, an educated, able local who can be trained by the researcher offers phonetic, sociolinguistic and cultural insights (Chelliah & Reuse, 2011; Heselwood & Howard, 2008).

7.12.4 Linguistic context data is essential. Research has confirmed the importance of language use and social data as factors contributing to variation in acquisition of multilingual children's phonology (Archer, 2013; Lebon-Eyquem, 2015).

7.12.5 Understanding the local phonology. In a creole language, which is undergoing diachronic and synchronic change, it is important to measure what is locally in use.

7.12.6 Developing local assessment tools. Developing a culturally and linguistic sensitive measurement tool (Carter et al., 2005; McLeod, 2012) is part of the research process when no such tools already exist. Such tools will reduce cultural bias and measurement validity.

7.13 Summary and Conclusions

This study set out to describe TP phonology in a semi-urban PNG population. It also had the goal of commencing the research support for fledgling SLP services in PNG. The findings gave insights into TP phonology in its multilingual context.

7.13.1 Characteristics of this phonology. Universal features were identified in phonological acquisition and developmental processes patterns seen in the children of this study. The early acquisition of the plosive manner and a generally later acquisition of the /r/ phoneme have been identified. There were also language specific features, such as the somewhat language-specific pattern to mastery of the fricative feature. The possible impact of interference from the lexifier and substrate languages on children's developmental error patterns is also apparent with the

lateralisation of /r/ and high level of fricatisation and lateralisation being language-specific processes. The use of phoneme /f/, first seen in the adult pilot study, was confirmed. Both independent and relational measures identified that the individual combination of universal and language specific features led to variation being a distinctive feature of this population's phonological acquisition.

The outcomes of this study provide an initial developmental survey of the acquisition of TP phonology. This study has been a valuable addition to the limited number of creole language developmental studies presently available (Archer et al., 2018; Escure, 1997; Lebon-Eyquem, 2015; Meade, 2006; O'Shannessy, 2005; Yava & Beaubrun, 2006; Youssef, 1991). It has performed an important function for any cross-linguistic study, it has shown that there are more than articulatory constraints on the maturation of children's phonology, that they are able to be responsive to the demands of their ambient languages (Ingram, 1997). It has been the first clinical linguistic phonological developmental study in Papua New Guinea and will hopefully provide a foundation for future research and provision of SLP clinical services to the linguistically diverse population of PNG.

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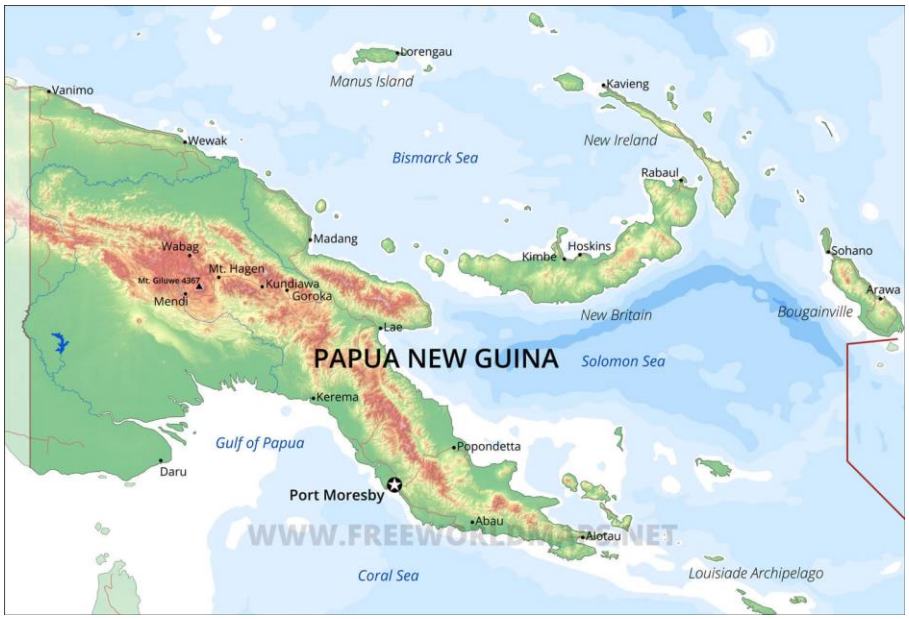
Appendices

Appendix A. PNG map

Figure A1. Papua New Guinea map ("Papau New Guinea," 2018).



FREEWORLDMAPS

Appendix B. Sample of Scholarly Literature and Resources for Tok Pisin.

This is merely a sample, but contains the key writers whose careers began in TP. These works are without exception, not interested in any clinical application of TP, although Siegel has applied his knowledge of TP to issues in literacy.

Table B.1 Tok Pisin Literature

Author	Date	Title	Contribution
Alexander Aikhenvald	2014	Living in many languages: linguistic diversity and multilingualism in Papua New Guinea.	Modern interaction of Tokples and Tok Pisin (TP)
(Bee, 1972)	1972	Phonological interference between Usarufu and Pidgin English	Impact of a Tok Ples on Tok Pisin phonology

Brash (Brash, 1971, 1975)	1971	Tok pilai, tok piksa na tok bokis	Figurative richness of TP
	1975	Tok Pisin!	
Cass,Phillip	1999	Tok Pisin and Tok Ples as languages of identification in Papua New Guinea	Sociolinguistics of TP- role in national identity of PNG
	2000	Yu Mas Kamap Wan Nesen". The Mainstream Churches, Tok Pisin and National Identity in Papua New Guinea.	
Slone, T.H.	2014	A bibliography of Melanesian Pidgin English dictionaries,	Comprehensive record of texts on TP.

		phrase books and study guides	
Connelly, Bob and Anderson, Robin	1983	Highlands trilogy: First Contact, Joe Leahy's Neighbours, Black harvest	Documentary films re WHP early contact with white settlers.
(Devette-Chee, 2011, 2016)	2011 2016	Decreolization of Tok Pisin. Attitudes towards the Use of Tok Pisin and Tolai as Languages of Instruction in Lower Primary Schools in Kokopo, East New	21st century TP use in education.

		Britain Province, Papua New Guinea.	
(Franklin & Thomas, 2006)	2006	Tok pisin idioms	
Kulick, Don	1992	Language shift and cultural reproduction; socialization, self and syncretism in a Papua New Guinean village.	Sociolinguistics of a shift from Tokples to TP.
(McElhanon, 1975)	1975	Tok Pisin i go we?	Edition of Kivung (journal of LSPNG) devoted to TP
(Meyerhoff, 2000)	2000	The emergence of creole subject-verb agreement	Grammar of TP creole.

Mihalic, Francis	1971	The Jacaranda dictionary and grammar of Melanesian pidgin	First dictionary of TP. Various on TP journalist style, guides for writing. 'Wantok' editor.
(Mühlhäusler, 1982, 1990)	1982 1990	Language and communicational efficiency: The case of Tok Pisin. An Advanced Course in Tok Pisin. Tok Pisin texts	Various: creole status of TP.
Paliwala, Adam	2012	Creole/superstrate code-switching:	Code-switching and the creole

		analysing the dynamic relationship between Tok Pisin and English in Papua New Guinea	continuum in TP
Romaine Suzanne	1992	Language education and development: urban and rural Tok Pisin in Papua New Guinea	Child study of TP use Morobe. + various
Smith, Geoff	2002	Growing up with Tok Pisin	Adolescent creole TP use. APICS data base for TP.
Sankoff, Gillian	1977	Multilingualism in Papua New Guinea. (+various)	Creolisation of TP.

			TP sociolinguistics.
Siegel, Jeff	1992	The Future of Tok Pisin: Another Look. (+ Various)	TP creole or stable pidgin status contact language literacy. APICS database TP.
(Verhaar, 1995)	1995	Toward a reference grammar of Tok Pisin: An experiment in corpus linguistics.	Grammar of written TP
(Wurm & Mühlhäusler, 1985)	1985	Handbook of Tok Pisin	Edited reference on typology and

			sociolinguistics of TP.
Zgraggen, John	1970	Texts in Tok Pisin (PNG)	Recordings of Tok Pisin

Appendix C. Adult Pilot Study: Words and Pictures with Responses.

Table C1. Adult Responses to words and pictures, Book 1.

Word	Page no.	Picture no.	Description of picture	Alternate words elicited	Alt2	Alt3	Reason Not elicited
wara	intro	intro	river with mountains and bush				
mama	1	1	mother and baby	meri	balus		
beibi	1	1		nana			
mama	2	2	white family; mother, fa child.	wait meri			
papa	2	2		dedi			
beibi	2	2		nana			
femili	2	2		wait lain			
simuk	2	3	smoke from mumu, man	smuk	kukim	ston	
painapol	3	4	pineapple on wooden tray				
meri	3	5	woman making a bilum				

wait man	3	6	pilot with lei	pailot	laf		
flauwa	3	6					
nek	3	6					
waswas	4	7	girl under a waterfall				
wara kalap	4	7					
klos	5	8	clothes pegged clothesline				
hangamapim	5	8					
patau	6	10	mother duck with row of ducklings on a log.	pisin			not recognised- European duck
singsing	5	9	women, traditional dress dancing	bilas			
binantang	6	12	praying mantis				wrong word use
draiva	7	14	man driving car from inside				too dark, unclear
faipela	7	13	5 muli, 5 bananas	faiv	banana	muli	not counting yet
kap	8	15	PNG red mug with flag	PNG	fleg		
bilum	8	16	2 women with heavy bilums	meri	‘brella’		
rot	8	16			maket		
kapbod	9	17	wooden cupboard	cup-pleit	‘snax’		

bata	9	18	avocado			
bulmakau	9	19	2 cows, water tank	kau		
viles	10	20	Sepik village, palm, houses, flowers	ples		
nambis	10	21	wait meri	wokabaut	solwara	
matmat ples	11	22	graves	matmat	flauwa	gumi
dok	11	23	papi	blek		
didiman	12	24	gardeners working in a kaukau garden	fama	lain	
gaden	12	24	kaukau garden	kaukau	man	
pisingras	12	25	girl with feather head-dress	bilas		
antap	12	25				
het	12	25				
lotu	13	26	gita	paitim		

kendol	14	27	candles; one in tin	tinpis			extra features focussed on
lek	14	28	foot in sandal	sandol			other features
lapun	14	29	old man in full regalia	bilas			other features
wos	15	30	watch	hanwos	klok		wrong name, inexperience
waswas	15	31	2 women swim				
klaud	15	32	coastal scene with clouds	wara			not local
sisis	15	33	scissors				
sel	16	34	large conch shell	NE			not known
fis	16	35	fish in sink	sink			
masin	16	36	sewing machine				not known
zipa	16	37	jipa	hanbek	mangi	skul	other focus
pikinini	17	38	children with ballons on old bus	balun			

jalopla	17	38					
bas	17	38					
raitim	17	39	pikinini meri				
retpla	18	40	poinsettia flower	flauwa			
rot	18	41	4WD on muddy road	hanrot	kar	maunten	
baret	18	42	long drain in new garden	gaden			focus, word use
tomato	19	43					not known
pusiket	20	45	kitten				
kundu	20	46	man making drum from log	hul			
pik	20	47	pig on grass	gras			
holim	22	49	woman with guitar, boy.				
gita	22	49					
bris	22	50		bus ples			
bagarap	22	50	bruk				
tisa	23	51	tiʧa	lain	bus	meri	ʧ used
masis	23	52	box matches	bokis			

mas	23	53	masis			target ʃ not used
viles	24	54	village compound	ples	nais	worduse
kauwar	24	55	ginger	ginger		worduse

Appendix D. Adult Pilot Study. Summary of Individual Analyses and Results.

Table D1. Adult phonological analysis results.

Participant number	[v]Data	[z]Data	[ʃ]	[θ]	[ɬ] From substrate	[s]/[ʃ] Contrast	[tʃ] Data & contrast	[dʒ] Data & contrast	Summary
1	four uses SIWI and SIWW no [f] contrast seen. Standard TP	Present twice with contrast in non-loan words	6 words SIWI, SIWW, SFWF. 7 occasions 2 similar pairs c/ [s] Strong	-	1	two occasions, SIWI and SIWW but in 3 loanwords No contrast	Similar pairs; klos/ wotʃ Siti/ tʃimbu tʃekim; 3 uses Free V /tʃ/ with [s]	SIWI and SIWW Free variation[dʒ] with [s] SFWF. No contrast	[ʃ] usage strong and contrastive but possibly as a code switch with new loanwords . [z] emerging
2	SIWW x1	0	Once in a recent	-	-	1 recent borrowing	0 found	SIWW & SFWF ‘ginger,	Standard TP except

	Standard TP		borrowing. weak			ʃop		dʒipa/sink dʒiwaka. Contrast with [s] sısıs/ brıdʒ. SIWI, SFWF s/dʒ contrast	[dʒ] SFWF & contrast to [s].
3	[v] ltd use FV with [w] Standard TP	FV + [s], SFWF use	FV with [ʃ]/ [s]as well as 3 sim pairs weak	-	yes	Free variation with [s]	4x Free Vn (FV) with [s] in SFWF.	6x[dʒizus], dʒıpa, piendʒi, dʒıwaka No similiar pairs.	New consonants but little contrast, [ʃ] est
4	SIWW position, No [b] substitution. Standard TP	Twice only but once SFWF-	Once [fiʃ] but similar pair with [s]. weak	2	-	One pair [s]/[ʃ], and [s] /[dʒ] SIWW	FV [s] and [ʧ], [s], [s] and[dʒ] 2 sim pairs. SIWW, & SFWF No SIWI use.	two similar pairs [s,dʒ], all positions.	Emerging [tʃ]& [dʒ]. Limited data

		code shift?						Sim pair affricates;	for [ʃ]
7	Three uses in SIWI and SIWW Standard TP	-	3 uses weak	-	-	[pɪs] Contrast [sisi] [masis]	Once, free variation with [dʒ]	Six times including SFWF	Standard TP but some [ʃ]. Unestablished final [dʒ] use.
9	SIWI,SIWW Ltd sample	-	SIWI,SIWW,SFWF 6 uses 5words	Θripla only	-	One similar pair but free variation	SIWIx1, SIWWx1 & SFWFx2 Con[ʧ],[dʒ]&[s] est.	SIWI only A similiar pair with [tʃ]	[ʃ]in FV. some loan words θ and

	One sim pair with [f] Standard TP						FV sel/ʃel		creole use of affricates
10	3 uses; SIWW, as standard TP SFWW SFWF creole	1 as plural	FV but all positions	θripla	-	Free variation so no contrast. All positions.	SIWI, SFWF replace [s].brɪʤ/woʧ/ klos. similiar pairs est. [s]/affricate. Contrast.	1 sim pair contrasting with [tʃ]	[v], [tʃ] Creole uses
11	SIWW standard TP, SIWI, SFWW new	[brɪz] Contrast with [s]	SIWW x2 recent borrowings weak	-	-	No FV, no similar pairs.	Contrast with [s] no contrast with [dʒ], FV	FV with [v] and [tʃ] No contrast	[ʃ] Insufficient data for contrast.

	creole uses						SIWI,SFWF	[dʒ] no contrast. [tʃ] contrast with [s]
12	4 uses 2 SIWI, 2 SIWW Standard TP	once as plural	-	1	1	- No [ʃ]	5 uses in all position. Sim pairs with [s] SIWI but FV SFWF.	No FV or sim pairs with [tʃ]	New SIWI use of [v] [tʃ] new, [s] contrast established.

13	Three uses SIWI and SFWW. Standard TP	4 uses all positions	5 uses SFWF. FV with [s]	-	-	No contrast with [s] and [ʃ]	SFWF, SIWW Contrast with [s]	Sim pairs with [ʃ] 7 [tʃ] but FV. 1xSFWF bridʒ/sisis	[ʃ] not contrasted. [v] usage standard.
16	[v] 8 uses, 6 words. SFWW position new.	[z] all posit/, over used. [s] /[z] contrast	[ʃ] 3 uses, FV with [s]	-	-	FV [s]/[ʃ] Contrast [ʃ] / [ʧ] minimal pair.	Contrast with [ʃ] and [dʒ] Unstable use of voicing with fricatives and affricates	Contrast with [ʃ] and [dʒ] [dz] and dʒ!	Expanding [v], [z], [ʃ] use.
total	[v] 9/12 standard TP	[z] 7/12	[ʃ] 11/12 speakers	[θ]5 /1x2	3 /	[ʃ]Present; 11/12 Contrast;	[tʃ]Present ; 11/12	[dʒ]Present all, contrast	12/12 Some creol

	3/12 strong	parti cipa nts.	1 2	3/12 Contrast [s/ʃ] 4/12	Final contrast with [s]&affrica tes; 4+	[ʃ] or[[tʃ] 6/12	e chan ges to fricat ives &affr icates

Summary: Each participant showed some kind of creole variation to standard TP fricative or affricate use. Use of [v] was largely unchanged. [z] was seen infrequently with 58% speakers, but the new phonemes [ʃ] and [tʃ] were seen in 92% speakers. 25% used [ʃ] contrastively as a phoneme, 50% used [tʃ] as a phoneme.

[v] 75% had unchanged standard TP use. 255 had creole uses of SFWW and SFWF positions.

[z] 58% had introduced [z] into their speech but not as a regular contrastive use in their phonology for 92%. One (8%) had [z] in all positions.

Appendix E: Adult Pilot Study: Voiced Consonant Use by Participant.

Table E1 Adult Voiced Consonant Use.

Participant number	Phonological evidence	Conclusion	Yes1, No 2
1	Some infrequent uses of final voiced plosives e.g. [bag], flæg].	Emergence of final plosive voicing.	1
2	Final voiced plosive used contrastively	Final voicing of plosives emerging through borrowings Contrast established SFWF velar plosives	1
3	There is creole innovation in the emergence of final voiced plosives, seen in similar pairs for the bilabial, alveolar and velar plosives. Still some free variation	Many similar pairs SFWF suggest developing contrast but free variation so not contrastive yet.	2
4	Many similar pairs but one example of FV with alveolar SFWF consonants	Emerging contrast not yet established.	2

5	Alveolar and a velar SFWF plosive. (also affricates)	Final voicing established- no devoicing finally	1
7	Some final voiced consonants- plosives and affricates.	Final devoicing	2
9	Alveolar and velar SFWF affricates +no FV+ sim pairs	Final voiced plosives and affricates established	1
10	[v], [dʒ], [d] and [g] found SFWF, however, persistent SFWF devoicing.	Final voicing not established	2
11	Alveolar and velar SFWF voiced consonants.	Final voicing established	1
12	Despite some SFWF voiced plosives, many uses of devoicing finally	Final voicing not established	2
13	Final alveolar voiced plosives, fricatives, affricate but some fricative devoicing and FV as in [bus]	Final voicing not established	2
16	Present but FV with final unvoiced plosives and some devoicing seen	Final voicing not established	2

TOTAL	Final voiced plosives without FV with SFWF position seen in 4/12 participants or 33%,	5/12

Appendix F. Child pilot: Words kept and discarded

Table F1. Child pilot word response and discards.

Words kept	Words discarded	New word book 2	Pictures kept	Pictures discarded	New pictures
painapol	mumu	femili	femili	mumu	
faipela	simuk	wara		white family	
faiv	bilum (reinstated book3)	muli		tupela meri karim hevi	
banana	wokim	banana			
muli	flauwa	retpela (kap)		draiva picture too dark	
kap	nek	boy			
dok	pisin	digim			
waswas	bungbung	baret			

sisis	kot	raitim		
fis	binantang			
zipa/jipa	kapbod			
kakaruk	bulmakau			
meri wokim bilum	didiman			
pik	pisingras		pisingras bilas	bilas fes boy
sikarapim	antap			
kokonas	het			
gita	bas			
lif	jalopela			
matmat				
mama				
papa		Jisas		

beibi/nana		tebol			
man	viles	kerot			
wara kalap		wara		waterfall	
bata	kauwar	maunten	ginger		
gaden	kandol	guava		kaukau garden workers	
lotu	lapun	jangpela			
lek	watch	sandol			
baret	maket kaikai	pusiket			ol mama wasim kap-plet
kundu	matches (masis)			man wokim kundu	man paitim kundu
bris	match (masis stik)			bris em I bagarap	sekim bris
tisa					teacher with bush class.

Appendix G. Books Two and Three, PNT Word Targets

Table G1. Word Targets by Picture, Book 2

Picture number	Words targeted
1	mama, papa, beibi, pikinini, femili
2	painapol
3	retpela kap
4	meri wokim bilum
5	tupela bata
6	dok
7	pik waswas long solwara
8	chili lombo
9	haus kunai, gaden
10	hanwos
11	tisu
12	kakaruk
13	pis
14	tisa, skul pikinini
15	sel
16	salim loli long haus sel
17	zipa
18	sisis
19	beach/bis, meri wokabout long arere long solwara
20	ginger
21	ol mangi/pikinini long jalo bas
22	anian
23	pikinini long bris/ bridge

Picture number	Words targeted
24	bilas, paitim kundu
25	tupela, triplela, faipla muli, banana mau
26	dokta sekim maus
27	ol man digim baret
28	kar go long rot
29	kofi lif
30	mangi. Bilas long pes
31	meri hangamapim bilum long banis
32	brata, klaut, diwai, maunten
33	kerot
34	guava
35	lek, sendol
36	tebol
Supplementary trial pictures and words	
37	jangpela /jut lotu. Jisas
38	skul pikinini
39	pikinini kakaruk
40	maunten, diwai, Mt Kuiya
41	ol mama wasim kap plet
42	garlic (late addition)
43	ol man piksim kar taia (late addition)

Table G2. Book 3 Frequency of phoneme opportunities by syllabic position.

Phoneme	SIWWI	SIWW	SI. Cluster	SFWW	SFWF	SFWF Cluster
p, pʰ	7	4	pl 4		1	1pl (alt)
b	6	3	blek-1			
t, tʰ	4	3	tripla, faipla, jaŋpla, tupla		4	
d	4	2	draiva-1			
k, kʰ	8	3	klaut-1 skreipim-1		4	
g	1	2				
m	4	2			5	
n	1	7		5	3	
ŋ				3	1	
w	2					
l	3	7	flek-1	1		3
r, ɾ, ɹ	1	6			1	
j	2	1				
f	3	1				1
v			2			1 (alt)
s	2		skul-1, skreipim-1x3		7	
z		1				
ʃ	no formal opportunities.					fɪʃ
ʧ		1				
ʤ	3	2				

h	1	1	

Appendix H. Sample Photographs: Picture Naming Task.

haus kunai, 'grass roof house'

wilwil kar 'toy wheel car'

painapol, 'pineapple'

baret, 'drain

man pixim su
'man fixing shoes'

Appendix I. Parent /Caregiver Information Sheet And Consent Form: TP and English

1. **Tok Pisin**

Table I1. Tok Pisin Consent Form.

GIVIM TOKSAVE LO TOKTOK LO FEMILI BILONG MIPELA

Wok lo lainim pasin lo toktok lo olgeta pikinini husat save mekim Tok Pisin lo Mt Hagen,

Mrs Jennifer Boer, Mt Hagen Haus sik na Curtin University WA, Australia.

Inap yu bekim olgeta askim yu lukim igo daun. Mi tok tenkyu tru lo givim toksave lo mi wantaim skul bilong

mi insait lo dispela askim lo toktok lo lain b'long yupela. Em bai halipim mipela long kisim save lo pasin bilong

olgeta pikinini lainim toktok lo em, na niupela pasin lo Tok Pisin em i kamap.

Nem lo pikinini: _____

Nem lo papamama o wasman husait lukaitim dispel pikinini:

papa_____

Mama_____OR Wasman_____

Table I2. English Parent Information and Consent Letter.

Parent/caregiver Information and Consent Form and information

Tok Pisin Speaking Children's Speech Survey- Parent and Guardian information and consent form.

Jennifer Boer
Masters Student
School of Psychology &Speech Pathology
Curtin University
c/- MAF P.O. Box 273 Mt Hagen,
WHP, PNG

Dear Parent/ Guardian

TOK PISIN RESEARCH PROJECT Mt Hagen,

My name is Jennifer Boer. I am a qualified Speech Language Therapist doing a research project in Mt Hagen. My project is supervised by Associate Professor Cori Williams, at Curtin University, Western Australia. I plan to find out

about the talk of children between age 3 and 6 years who speak Tok Pisin as their Tokples, their first and most important language.

I am currently looking for healthy children who use Tok Pisin as their first language to be part of this project.

What does participation in the research project involve?

This study will have three main parts: a parent/caregiver interview, a naming task for adults, and a child speech assessment. You are invited to a meeting at your child's school to hear all about the project and to ask any questions you may have, and to give any comments you want to give.

On another day, when I will attend your child's school, I will ask your child to come with another child to a quiet room to look at a picture book and name the pictures in Tok Pisin. This will take about 40 minutes. I will talk with your child's teacher and the Teacher in Charge, to do this work at a time that does not disturb the school or your child's learning. The session will be recorded on a voice recorder, with your approval. With your permission, this recording will be kept for future research.

If you would like to have your child's results on the naming task, I am happy to meet with you either at the school or the Mt Hagen Provincial Hospital and explain these results.

Do my child and I have to take part?

No, it is your choice. This decision should always be made completely freely. You yourself can choose if you want your child to attend or to participate in my adult assessments. All decisions made will be respected by myself and the school without question.

Your child has been given a letter in Tok Pisin from us about the project, which gives them an opportunity to give their consent. I will read it to the class. Please would you read it with them? I encourage you to look at it with them and discuss it with them before they decide whether they want to take part.

What if either of us was to change our mind?

Even if you decide to take part, either you or your child can change your mind at any time. What you choose will not change how I feel about you and your child, or how your child's teacher or school feels. Even after taking part, we can destroy any information we have collected about your child, unless we have already published a paper or report on the study.

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

Your privacy is very important. We will remove you and your child's name and any information that could be used to identify him/her, or you, from the information we collect. No information about you, your child or the school your child attends will be published. We will be using an audio recorder to record you and your child's speech but only those involved in this research can listen to the recording.

We will safely store the information for a minimum of 7 years so that only the researchers can see it, and then it will be destroyed by shredding hard data and deleting computer files.

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

Your privacy is very important. We will remove you and your child's name and any information that could be used to identify him/her, or you, from the information we collect. No information about you, your child or the school your child attends will be published. We will be using an audio recorder to record you and your child's speech but only those involved in this research can listen to the recording. We will safely store the information for a minimum of 7 years so that only the researchers can see it, and then it will be destroyed by shredding hard data and deleting computer files.

Please answer the questions written below. You can bring this letter when you come to the school on (date) to meet me and learn about the project. If you would like me to explain the form further some more, I can do that on another day that suits you.

Thank you for providing this information, which will help us to understand how your child learns their language.

Who has approved this study?

Curtin University Human Research Ethics Committee (HREC) has approved this study (HREC number). Should you wish to discuss the study with someone not directly involved, in particular, any matters concerning the conduct of the study or your rights as a participant, or you wish to make a confidential complaint, you may speak to the Teacher in Charge at your child's school, or to

Please answer the questions written below. You can bring this letter when you come to the school on (date) to meet me and learn about the project. If you would like me to explain the form further some more, I can do that on another day that suits you.

In addition you may contact the Curtin University Ethics Officer on (+61 8) 9266 9223 or the Manager, Research Integrity on (+618) 9266 7093 or email hrec@curtin.edu.au.

Jennifer M Boer

Speech –language Therapist, Mt Hagen Provincial Health Authority

I3. Parent Consent Form.

This project is a survey of the way children who use Tok Pisin as their Tokples, are changing and developing the language. Thank you for allowing your child to be part of this research project into Mt Hagen talk.

This form gives consent for your child to be shown the stimulus pictures to help them talk and have their talk recorded. They will be asked to name and tell stories about the photos of everyday PNG things and activities.

You will be asked to complete this form to show you are wanbel with the project, the researcher Jennifer Boer and the school allowing your child _____to participate in this language research project, the **'TOK PISIN- SPEAKING CHILDREN'S SPEECH SURVEY'.**

We have attended a meeting with the teacher and researcher and I have been informed of and understand the purposes and manner of the research. I/we understand the purposes of the study and what our child will do. We agree for our child to be seen, with another child, in a quiet room outside the classroom. We agree that the older child will show them the pictures to name.

I/we have been given an opportunity to ask our questions, and so has our child_____.

I agree to participate in the study as outlined to me, and sign here to show my agreement;

I/We _____ the parents/ guardians of

_____ give our permission for our child to participate.

Father_____Mother_____

Child's name or initials: _____

Parents or guardians' names or initials: Father_____

Mother_____ OR Guardian_____

Occupation of parents;

Parental education level completed if you can say; Mother: _____Father:_____

please tick any boxes that apply to you and write anything extra you would like to say.

Appendix J. Family Language Use and Occupation Survey with Nominal Ratings

Child's name or initials: _____

Parents or guardians' names or initials: Father_____

Mother_____ OR Guardian_____

Occupation of parents;

Parental education level completed if you can say; Mother: _____Father:_____

please tick any boxes that apply to you and write anything extra you would like to say;

Table I. 1 Parental Occupation

Father	Mother	Guardian	SES score summary
Garden own land	Garden own land	Garden own land	
Selling garden produce	Selling garden produce	Selling garden produce	
Business	Business	Business	
Employment	Employment	Employment	
Education level attained	Education level attained	Education level attained	

Church or community work	Church or community work	Church or community work
Other – please describe.	Other	Other

Summary **Family**

Family Tokples; Melpa, _____ other_____ mixed_____

What age did your child first hear Tok Pisin talked_____? English?_____

What language does your child choose to speak most often? Tokples___? Tok Pisin__ English?_____

It is helpful for us to know if you and your child are able to hear or read Tok Pisin on the radio or in books and the newspapers.

Please tick which of these activities your child and your family often share.

Table J.2 Language use.

Activity	How often?	Your comment	Language score
Read magazines, books or newspapers in Tok Pisin, e.g. 'Wantok'	Daily/weekly/other		
Read English newspaper	Daily/weekly/other		
Watch English TV or movie	Daily/weekly/other	Own TV?	
Watch Tok Pisin TV or movie	Daily/weekly/other		
Hear English radio	Daily/weekly/other		
Hear Tok Pisin radio	Daily/weekly/other		

Nominal ratings summarising language use and SES data for SPSS

Language use

1. English media and writing predominantly, mixed TP and English conversation
2. Mixed English and TP media, literature and conversation
3. Mixed Melpa and TP conversation, mixed media and TP. Includes English TV
4. Tokples and TP only, little media exposure

Table J. 3 Language use Summary

Survey item	Points Tokples Melpa	Points Tok Pisin	Points English
Dominant Household language			
Parent language			
reading			
writing			
Radio language			
Sometimes Watch TV			
Weekly watch TV			
Daily watch TV			
TOTAL			

Rating Categories: Family occupation/SES

1. Tertiary educated parent, professional occupation
2. Secondary educated parent/business/skilled employment
3. Subsistence farmers with business/unskilled employment. Secondary/primary educated
4. Subsistence farmer, primary education only.

Table J. 4 Summary of Parental SES

SURVEY ITEM	MOTHER	FATHER
parent education primary		
Parent education 2ndary		
Parent education tertiary		
Farm work		
Sales		
Employment		
Business owner		
Professional role		
TOTAL		

Appendix K. Language Use by Site and Age Group.

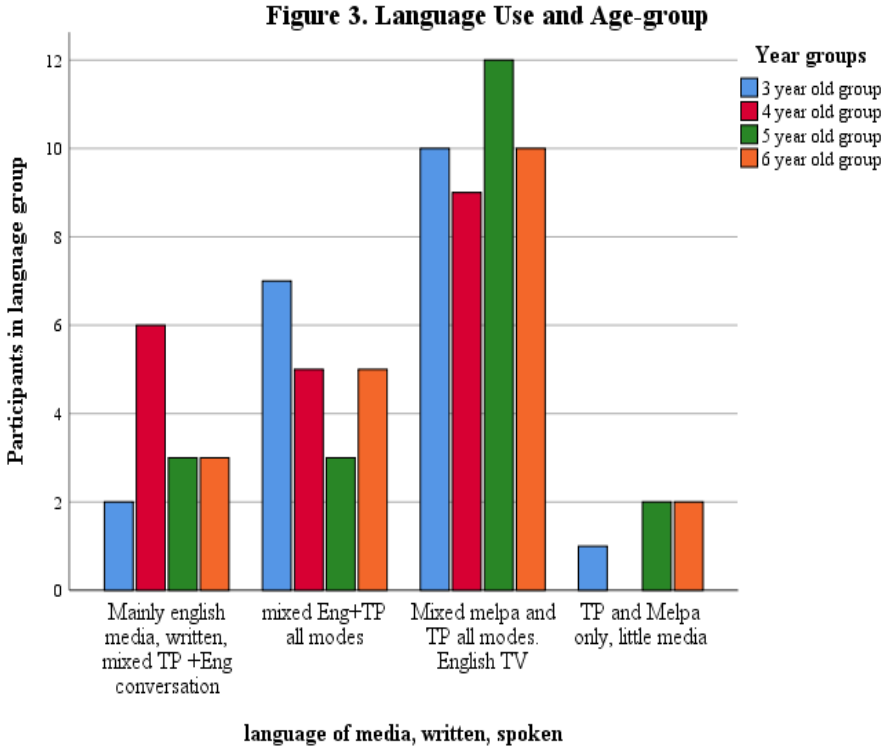
Language use groups were not distributed equally. The largest groups were Category 3: *Mixed Melpa and TP all modes. English TV.* The next largest category, which was less than half of category three, was *Category 2: Mixed English +TP all modes.* Thus the Categories where TP dominated were the largest. The smallest by a significant margin were the 5 families who had mainly Melpa with some TP and no access to media.

Table K1. Language Use by Site and Age-group

Site	Language Category 1.	Language Category 2	Language Category 3.	Language category 4.	Total
AOGW	0	1	1	1	3
Kalina Pre School	4	8	9	0	21
Kuri Community	0	1	14	2	17
Mt Kuiya	1	1	8	1	11
Naz Rebiamul Church Community	0	1	1	1	3
Susumamas Staff Child	1	0	0	0	1
YCR Pre School	8	8	8	0	24
Total	14	20	41	5	80

Note: Legend: Language Category 1. Mainly English media, written, mixed TP +English conversation. Language Category 2: Mixed English +TP all modes. Language Category 3: Mixed Melpa and TP all modes. English TV. Language Category 4: TP and Melpa only, little media

Figure K1. Language use by age group.



Appendix L. Child Consent Form

CHILDREN'S CONSENT FORM-ENGLISH and TOK PISIN.

- I know that I can say 'yes' or 'no' for doing this project.

Mi save, mi ken tok orait o nogat long dispela wok b'long Jennifer.

- I know that I can stop whenever I want.

Mi save, mi ken pinis wanem taim, mi laik.

- I know that I will be looking at pictures, naming them and telling my stories about them as part of the project.

  Mi save, mi bai lukim piksa na givim nem long en, na tokim ol stori bilong mi igo long Jennifer long wok bilong en.

- I know that what I say will be recorded.

  Mi save, Jennifer bai raitim igo daun long book na masin bilong en, long wanem samting mi toktok long en.

- I know that I need to draw a circle around the smiley face on this page before I can help with the project.

Mi save, mi mas putim mak raunim dispela amamas pes, long dispela pepa pastaim, na bihain mi helipim wok bilong Jennifer.

Mi tok orait sapos mi laik helpim Jenifer

Mi tok nogat.

Appendix M. Frequency of phoneme opportunities by syllabic position Book 3.

Table M1. Phoneme Opportunities Book 3.

Phoneme	SIWWI	SIWW	SI.CLUSTER	SFWW	SFWF	SFWF CLUSTER
p, pʰ	7	4	pl 4		1	1pl (alt)
b	6	3	blek-1			
t, tʰ	4	3	tripla, faipla, jaŋpla, tupla		4	
d	4	2	draiva-1			
k, kʰ	8	3	klaut-1 skreipim-1		4	
g	1	2				
m	4	2			5	
n	1	7		5	3	
ŋ				3	1	
w	2					

l	3	7	flek-1	1		3
r, ɾ, ɹ	1	6			1	
j	2	1				
f	3	1				1
v			2			1 (alt)
s	2		skul-1, skreipim-1x3		7	
z		1				
ʃ	no formal opportunities.					fɪʃ
ʧ		1				
ʤ	3	2				
h	1	1				

Final target words and phonemic targets analysed in child study. 67 target words. Book 3

Table M-2 Book 3 target words and phonemes by syllabic position.

Target	Tar SIWI	Tar SIWW	Tar SIWW2	Tarsiww3	Tar SFWW	Tar SFWF	Vowel
ginger	ʤ	ʤ			n		ɪ
wara	w	ɾ					a
maunten	m	tʰ			n	n	e
diwai	d	w					ɪ
klaut	kʰl					tʰ	au
papa	p	p					a
mama	m	m					a

beibi	b	b			i
femɪli	f	m	l		e
painapol	p^h	n	p^h	l	ai
tupla	t^h	pl			u
bata	b	t^h			a
faipla	f	pl			ai
faiv	f			v	ai
banana	b	n	n		a
muli	m	l			u
jalo	j	l			a
tɪsu	t^h	s			u
tebol	t^h	b		l	o

sɪkaɾapɪm	s	k^h	ɾ	p^h		m	ɪ
skɾeipɪm	skɾ	p^h				m	ei
kokonas	k^h	k^h	n			s	o
meɾi	m	ɾ					e
blek	bl					k^h	e
dok	d					k^h	o
pɪk	p					k^h	ɪ
solwara	s	w	ɾ		l		o
wasɪm	w	s				m	ɪ
waswas	w	w			s	s	a
wil	w					l	i
dɪgɪm	d	g				m	ɪ

baret	b	ɾ				t^h	e
kofi	k^h	f					i
kerot	k^h	ɾ				t^h	e
kar	k					ɾ	a
rot	ɾ					t^h	o
meŋgo	m	g			ŋ		e
paitɪm	p^h	t^h				m	ai
kundu	k^h	d			n		u
tiʧa	t^h	$t^hʃ$					i
skul	sk					l	u
pɪkɪnɪni	p^h	k^h	n	n			ɪ
tripla	tɾ	pl					i

kakaruk	k^h	k^h	ɾ			k^h	u
kap	k					p	a
fleg	fl					g	e
piendʒi	p^h		ʤ		n		e
haus	h					s	au
kunai	k^h	n					ai
gaden	g	d				n	e
salım	s	l				m	a
loli	l	l					o
selhaus	s	h			l	s	au
laulau	l	l					au
onijon				j	n	n	o

fɪs	f			s	ɪ
sɪŋsɪŋ	s	s	ŋ	ŋ	ɪ
naif	n			f	ai
draiva	dɾ	v			ai
daiv	d			v	ai
dʒɪpa	ʤ	p^h			ɪ
pasim	p^h	s		m	a
jaŋpla	j	pl	ŋ		a
lotu	l	t^h			o
dʒizas	ʤ	z		s	i
s	b	l		s	ɪ

balus	b	l		s	u

Appendix N. Elicitation rates by 6 month age-groups.

6 months Age Groups	Spontaneous	Prompted	Not Elicited
36-41m	50%	42%	9%
42-47m	61%	29%	10%
48-53m	68%	25%	7%
54-59m	70%	21%	9%
60-65m	71%	19%	10%
66-71m	75%	15%	10%
72-77m	77%	14%	8%
78-83m	82%	11%	7%

Appendix O. Definitions of processes observed and analysed.

The steps of process analysis were as follows:

All processes observed in the corpus of data were noted and total of occurrences for each process and each participant obtained. Process definitions and typology were derived from various systems described in Grunwell (1987).

Criterion for inclusion in results: process must appear 5 times in child's inventory(W. Cohen & Anderson, 2011)

Any processes satisfying the criterion of 5 times in a child's sample were included for analysis.

Table O1. Syllable Structure Processes Definitions.

Process	Definition	Example
Syllable Deletion	Omission of a syllable from target form.	'pikin' for 'pikinini'
Vowel Deletion		'femli' for 'femili' (participant 14)
Consonant Deletion		'ikrapim' for 'sikarapim' (participant 16)

Table O2. Substitution Processes Definitions

Process	Definition	Example
Voicing or Deaspiration	Substitution of a voiced plosive for an aspirated unvoiced plosive, or deaspiration of an aspirated unvoiced plosive.	[gofi] 'coffee' for [kʰofi] [kerot] 'carrot' for [kʰerot]
Stopping	Substitution of stop consonant for a non-plosive phone such as a fricative.	[bilat] 'decoration', for [bilas]
Dentalisation	A coarticulation of a consonant with a dental placement. Dentalisation of consonants is contrastive in Melpa language.	[roṯ] for [rot] [talɪm] for [salɪm]
Palatalisation	Palatal contact of the tongue during and substituting for a non-palatal sound	[ʎoli] for [loli]
Fricatisation	Substitution of a fricatised consonant for a non-fricative target consonant	[wɪɬ] 'wheel' for [wɪl]
Lateralisation	Substitution of a lateral consonant for a non-lateral consonant	[ɬɪkaɾapɪm], 'to scrape' for [sɪkaɾapɪm]
Deaffrication	Substitution of a single consonant for an affricate consonant.	[dɪzas] 'Jesus' for [ʤɪzas]
Liquid confusion	Substitution of a non-targeted liquid consonant for another consonant. In English it is usually [w] for [ɹ], but in TP it is more generally [l] for [ɾ]	[kelot], 'carrot' for [kerot]
Glottal replacement	Substitution of the glottal stop [ʔ] for another consonant	[selʔaus] 'shelter' for [selhaus]
Backing	Substitution of a back consonant for a front consonant	[tɪʃu] 'tissue' for [tisu] The most frequent instance of this process and a possible example of a creole substitution.
Fronting	Substitution of a front consonant for a back one.	[sɪnsɪn] 'sing' for [sɪŋsɪŋ]
De-voicing	Substitution of an unvoiced consonant for a voiced one	[faif], 'five' for [faiv]

Appendix P. Copyright Policy LLM

This information relates to the partial inclusion of material from previously published material (Boer & Williams, 2017)

Copyright policy of Language and Linguistics in Melanesia (LLM). https://www.langlxmelanesia.com/instructionstoauthors.htm)

1. Authors retain the copyright.

2. LLM promotes open access to knowledge.

3. LLM is in principle opposed to publishers having exclusive rights to distribute scientific information.

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