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The Relationship between Stereotyped Movements and Self-Injurious Behaviour in
Children with Developmental or Sensory Disabilities

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Abstract

Stereotyped movements (SM), including stereotyped self-injurious behaviour (SIB), are common among children with developmental and sensory disorders, but it is not known if SIB is a more severe form of SM or whether SIB and SM differ in kind. We developed the Stereotyped and Self-Injurious Movement Interview (SSIMI) to assess injurious and non-injurious SM. The SSIMI was administered to children with autism (n=56), intellectual disability (n=29), vision impairment (n=50), hearing impairment (n=51), and typical children (n=30). Results indicate that the reliability of measurement increases when SIB and other SM items are included in a single scale, that SIB is rarely evident in the absence of other SM (but not vice versa), that between group differences in the prevalence of SIB are paralleled by differences in the prevalence of other SM, and that correlations between SIB and other SM are moderately strong in autism, vision impaired, and intellectual disability groups but not in typical and hearing impaired groups. We conclude that the SSIMI is a useful measure of SIB and other SM. Among children with autism, vision impairment, or intellectual disability, SIB appear to represent a more severe form of SM. Both SIB and other SM may result from impairments in intellectual and sensory processing.

Key words: Stereotyped movements, Self injurious behaviours, Autism, Sensory Disorders, Intellectual Disability

Despite the harm that it causes (Tate & Baroff, 1966), the self-injurious behaviour (SIB) of people with developmental (Baumeister, 1978; Turner, 1999b) or sensory disorders (Baumeister & Forhand, 1973; Berkson, 1983, Brambring, 1992; Troster, Brambring & Beelmann, 1991) has little in common with the self-mutilation observed in psychotic persons (Alderman, 1997; Briere & Gil, 1998; Favazza, 1996) or the willful self-harm of suicidal persons or those whose self-harming behaviour has a social meaning (Baroff, 1974; Schroeder et al, 1978). As Matson et al. (1997) noted, the SIB of people with developmental disorders is frequently rhythmic and repetitive, that is, it closely resembles the repetitive and stereotyped movements (SM) that are a defining characteristic of autism (American Psychiatric Association, 2000; Schopler, 1995) and are common among persons with an intellectual or sensory disability (Murdoch, 1996; Rojahn & Sisson, 1990; Troster, Brambring & Beelmann, 1991).

In much of the early literature, SM and SIB were both described as belonging to a class of behaviour linked by repetition, rigidity, invariance and inappropriate continuance of the action (Baumeister & Rolling, 1976; deLissovoy, 1961; Turner, 1997; Wing, 1976). Discussions of SM often included SIB (Baumeister & Maclean, 1984; Gorman-Smith & Matson, 1985; Wiesler, Hanson, Chamberlain & Thompson, 1985), and Gorman-Smith and Matson (1985) classified SIB as a “substrate of stereotyped behaviours.” The main reasons for distinguishing these two forms of behaviour were differences in severity (i.e., the self-harming character of SIB) and the possibility that their performance resulted from different underlying mechanisms (Wiesler et al.). However, the question of whether SIB is a more severe form of SM, or, despite having

some shared characteristics, these are two distinct classes of behaviour has not been systematically addressed by research.

To date, available measures of repetitive movements have either excluded items that would assess SIB (e.g., Adaptive Behavior Scale; Godfrey, Frost, Snelling, & Knight, 1986) or have had an insufficient number of SIB items to sample this class of behaviour (e.g., Repetitive Behaviour Interview; Turner, 1999) or did not assess such characteristics as frequency, duration, or level of harm (Bodfish, 1999). In order to assess SIB, an assessment tool must sample the different ways in which children can and do injure themselves (e.g., banging, hitting, biting), the topographical location of the injury (e.g., head, hand), and the intensity or severity of the behaviour (e.g., physical damage caused). Only when this domain is adequately sampled can relationships between SIB and SM be assessed. For this reason, we developed the Stereotyped and Self-Injurious Movement Interview (SSIMI) to assess stereotyped body movements, stereotyped manipulation of objects, and stereotyped self-injurious behaviour.

Interview Development

The SSIMI is an adaptation of Turner's Repetitive Behaviour Interview. A list of SIB was compiled from a literature search of SIB within autism and other clinical groups. Eight items were selected on the basis of how well they discriminated SIB from other repetitive behaviours, that is, in addition to repetitiveness of movement, they had the clear potential for self harm. A brain storming process with paediatric specialists was also held. The expert review included 6 therapists and researchers who belonged to an autism journal club, and 4 educators who were experienced in the special education of children with autism, intellectual handicaps, or hearing and vision disabilities. These experts,

blind to the outcome of the literature review, were asked to nominate SIB that they had read about or observed in children with and without disabilities. Ten different items, including the 8 already identified, were suggested based on these people's clinical experience and professional knowledge. With the inclusion of the 2 items from Turner's scale, a total of 12 SIB items were included in the initial interview, plus 2 questions about the duration of SIB and the child's response to the interruption of SIB. After drafting items, a preliminary version of the interview was given to 6 experts for evaluation. Based on feedback received, two items were dropped. The final version of the SSIMI consisted of 32 items, 19 from Turner's interview assessing stereotyped manipulation of objects and body movements, 10 assessing specific SIB, and 3 assessing general characteristics of SIB.

INSERT TABLE 1 ABOUT HERE

Four ways of scoring the SSIMI were developed. The first measures how many different SM / SIB a child performs, the second measures the frequency with which each form of SM / SIB is performed (e.g., once or twice per week, 30 or more times per week), the third measures the duration of each performance (e.g., less than 60 seconds, more than 30 minutes) and the fourth measures the intensity with which SM / SIB are performed (e.g., 2 or 3 movements per 10 seconds, 10 or more movements per 10 seconds) (see Table 1 for examples). These different scoring methods result in four indices for each of the three categories of repetitive movements: manipulation of objects, body movements, and SIB. For SIB items, two additional scores are generated: how much effort is involved in the activity (minimal to maximal) and how damaging is the behaviour (no damage to life-threatening).

The SSIMI was piloted by administering it to two teachers of the deaf and one teacher of children with autism with respect to four children. The pilot study revealed that some questions could be misunderstood and these questions were reworded prior to use in the main study. The final SIB items are shown in Table 1.

Research Aims and Design

The aim of this research is to assess whether SIB differs in kind and / or in degree from other SM, and whether any such differences are common to children with different developmental problems or are specific to one or more developmental or sensory disorders. To achieve these aims, the SSIMI is administered to children with autism, an intellectual disability, a hearing disability, or a vision disability, as well as to typically developing children. If SIB differ from other SM only in degree, we expect that SIB items will be internally consistent with other SM items, that they will be evident only in children who perform other SM, and that relationships between SIB and other SM will not differ across samples. We also expect that between-group differences in the prevalence of SIB will parallel group differences in the prevalence of other SM. Other results will indicate that SIB differ from other SM in form.

Method

Participants and Procedure

Participants were recruited after this project had been approved by the Human Research Ethics Committee of Curtin University of Technology. Participants were 221 children (129 boys, 92 girls) aged 6 to 13 years (mean= 9.40, SD=1.81) comprising five groups: typical children (n=30, boys=14, mean age=8.75, SD=1.64), children with intellectual disabilities (n=29, boys=17, mean age=10.35, SD= 2.02), children with visual

impairments ($n=50$, boys=25, mean age=9.02, $SD=1.59$), children with hearing impairments ($n=51$, boys=31, mean age=9.29, $SD=1.73$), and children with autism ($n=56$, boys=42, mean age=9.71, $SD=1.86$). All participants were living with their families and were attending school, either a state school, segregated school or a semi-inclusive school in the Haifa metropolitan region of northern Israel. Children with a developmental or sensory disorder had been diagnosed by a physician or a psychologist from medical developmental services.

Typical children were a convenience sample of second to fourth graders recruited from a state school. Children with an intellectual disability had been diagnosed by psychological services according to DSM-IV criteria and all had a measured IQ less than 70. The educational system had also declared them as having a mild or moderate intellectual handicap and as being in need of special education. These participants were recruited from three special education segregated schools, i.e., schools that only educated children with an intellectual disability.

Children with visual impairments included two subgroups: those who had typical intelligence ($IQ>69$; $n=25$) and those who were also intellectually disabled ($IQ<70$; $n=25$). All of these children had been defined by medical services as legally blind / suffering from visual loss and, as a result, were eligible for special educational support. They were recruited from special school classes designed for them. Children with hearing impairments included the same subgroups: those who had typical intelligence ($IQ>69$; $n=34$) and those who were intellectually disabled ($IQ<70$; $n=22$). All of these children had been defined by medical services as requiring hearing aids and as eligible

for special educational support. They were recruited from special school classes designed for them.

Children with autism were diagnosed based on DSM-IV-~~TR~~ criteria and / or by the Childhood Autism Rating Scale (CARS; Schopler, Reichler & Rothen Renner, 1998). Half (n=28) of these children were identified by psychological services as having typical intelligence, and half were defined as intellectually disabled. All of these children were defined by psychological services as eligible for special education in a school for children with autism spectrum disorders and were recruited from two such special education schools.

For all samples, children were excluded if they had been diagnosed with other specific syndromes strongly associated with specific repetitive movements, including Lech Nyhan Syndrome, Cornelia de Lange Syndrome, Rilez Day Familial Dysautonomia, Fragile X Syndrome and Rett Syndrome. These syndromes are associated with an abnormal metabolism and / or a specific x-linked gene, and have known sensory abnormalities which differentiate them from other populations with intellectual disabilities. Children with tardive dyskinesia were excluded as well. In addition, the intellectual disability group did not include children with a diagnosed sensory loss or impairment.

Statistical tests indicate that groups differ in age [$F(4, 216)=4.14, p=.003$] and sex [$\chi^2(4)=9.71, p=.045$]. Post hoc tests indicate that children in the typical group are younger than those in the intellectually disabled and autism groups, children in the intellectually disabled and autism groups are also older than those in the visual and hearing impairment groups. Girls are overrepresented in the intellectual disability group

and boys are overrepresented in the autism group; the latter result is consistent with sex differences in the prevalence of autism.

The SSIMI (among other measures) was administered to the participants' teachers by the first author as a face-to-face interview in their home schools. Interviews lasted approximately 30 minutes per child.

Results

Relationships Between Scoring Methods

We began our analyses by assessing the extent to which the different scoring procedures produce non-redundant information by calculating Pearson correlations between the different scores. The results indicated that the correlations are so strong that the different scoring systems are essentially interchangeable. For stereotyped body movement items, correlations between scoring procedures ranged from $r = .88$ between prevalence and duration scores to $r = .95$ between prevalence and repetitiveness scores. For stereotyped manipulation of objects, the range of correlations was from .90 to .95, and for stereotyped self-injurious movements, was from .76 to .95. Children who perform a larger variety of SM also perform more repetitions of the SM, over a longer time period, and on more occasions. Children who perform a larger number of SIB show the same pattern, and also perform their SIB with greater effort which causes more damage. Because the different scoring systems are redundant, for the balance of this article we report results only for the number of different SM / SIB performed.

Relationships between SIB and other SM

In order to assess whether SIB and other SM differ in kind or in degree, we conducted a series of analyses. We first calculated Pearson correlations between the

different categories of SM to determine if they, like the different scoring systems, are essentially interchangeable. The results indicate moderate relationships between SIB and stereotyped manipulation of objects ($r = .51$) and stereotyped body movements ($r = .49$), and between manipulation of objects and body movements ($r = .49$). We next assessed whether items assessing one category are internally consistent with items assessing each other category by calculating reliability coefficients for each item category and for different pairs of item categories. The results indicate that each scale on its own has a low reliability coefficient ($\alpha = .57$ for manipulation of objects, $.66$ for body movements, and $.55$ for SIB), and reliability is always enhanced by combining items across categories (objects and movements, $\alpha = .74$; objects and SIB, $\alpha = .70$; movements and SIB, $\alpha = .74$; objects and movements and SIB, $\alpha = .79$). The analysis that included all items indicated that with only one exception, the deletion of any item would reduce the reliability of the scale, suggesting that all items contribute to a single SM construct.

To assess whether SIB items represent the more severe end of this construct, we assessed the likelihood of observing SIB in the absence of other SM (and vice versa) on the assumption that more severe stereotyped movements will not be evident in the absence of less severe movements. Cross-tabulation of responses indicated that among the 90 persons who performed at least one SIB, in only 3 cases (one in the typical sample, two in the hearing impaired sample) was it performed in the absence of other SM. Conversely, of the 170 persons who performed at least one non-SIB SM, it was performed in the absence of SIB in 83 cases. With few exceptions, the performance of SIB is contingent on the performance of other SM.

Consistency of Relationships Across Samples

SIB and other SM are evident in all samples, but the prevalence of these movements varies markedly across samples. This variation is to be expected because the samples also differ markedly in the known and hypothesised impairments that distinguish children with a disorder from typical children. However, if SIB and other SM are of the same form, it would be expected that how one form of SM varied across samples would be paralleled by how the other forms of SM varied across samples. We tested this hypothesis by ranking samples in terms of the prevalence of SIB and other SM. From most to least common, the proportion of children in each sample showing non-SIB SM was 98.2% (Autism), 86.0% (Vision impaired), 79.3% (Intellectually disabled), 67.9% (Hearing impaired), and 36.7% (Typical). For SIB, the order was identical: 64.3% (Autism), 52.0% (Vision impaired), 31.0% (Intellectually disabled), 30.0% (Hearing impaired), and 6.7% (Typical).

INSERT TABLE 2 ABOUT HERE

Finally, we assessed whether SIB and other SM have the same relationship to each other across samples by calculating the Pearson correlations between SIB and other SM scores separately for each group. The results (see Table 2) indicate that SIB and other SM are related to each other in children with autism, an intellectual disability, or vision impairment, but not in typical or hearing impaired children.

Discussion

The aim of this research was to construct an interview to assess both injurious and non-injurious SM, and then to discover whether SIB differ in kind and / or in degree from other SM, and whether any such differences are common to children with different developmental problems or are specific to one or more developmental or sensory

disorders. The SSIMI appears to have great utility in assessing SIB and other SM, and has enabled us to show that among children with autism, a visual impairment, or an intellectual disability, SIB are more severe than other SM but do not represent a different category of behaviour. Among typical children and children with a hearing impairment, there is no relationship between SIB and other SM, and therefore no evidence that these behaviours have the same underlying functions. This distinction between the SIB / SM of some clinical groups and that of both typical and hearing impaired children suggests that the stereotyped movements evident in children with autism, a vision impairment or an intellectual disability are functionally related to neurocognitive processes that are impaired as the result of the underlying disorder, and implicate both intellectual and sensory processes as the source of the problem.

In constructing the SSIMI, we wanted to ensure that the domain of SIB was adequately sampled, which meant that we not only sampled a variety of behaviour, but also sampled a wider set of behavioural characteristics, including frequency, duration, and intensity. Our results show that once the total number of SM has been assessed, the other indices provide no additional information. This is a useful addition to knowledge, because we now know that we can predict the likelihood of things like actual self-harm from the number of different SM that a child engages in. In practical terms, the need to assess only the number of SM reduces assessment time and so the feasibility of collecting this information.

The evidence that SM have a different form in different groups comes mainly from the finding that SIB and other SM are not correlated in the typical and hearing impaired samples. Because SIB was so uncommon in the typical group (two cases), the

possibility that the lack of a correlation in this group is due to restriction of range effects cannot be excluded. However, in the hearing impaired group, the range of scores on all SM indices was higher than in the vision-impaired and intellectually disabled groups, and three of the four ranges were comparable to those of the autism group. The difference between hearing impaired and other groups is not an artifact of differences in the distribution of scores. The fact that the three children in whom SIB was observed in the absence of other SM were from the typical and hearing-impaired samples is consistent with a conclusion that relations between these stereotyped behaviours are different in these samples.

The prevalence of SIB and other SM increases markedly when any developmental or sensory disorder has been diagnosed, presumably as a direct or indirect function of the impairments underlying these disorders. In our samples, the exact nature of the impairment is not known. What these samples have in common are impairments in intellectual and / or sensory processing, although the sensory processing dysfunction may reflect sensory loss (vision or hearing) or aberrant perception of sensory stimuli (autism). The observation that almost all children with autism show SM, and some two thirds of children with autism show SIB suggests that aberrant processing of sensory stimulation may be the most significant mediator of all SM (cf. Dunn, 1997; Miller et al. 2001), and may interact with intellectual problems (present in about half of all clinical samples; Poustka & Lisch, 1993; Rojahn & Sisson, 1990) to amplify effects due to either problem alone. Whether this is the case needs to be tested in future research.

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Table 1

Sample items from the SSIMI assessing self-injurious behaviour, and sample response formats for stereotyped body movements (A), stereotyped manipulation of objects (B), and stereotyped self-injurious behaviour (C)

SIB Items

1. Does (name) bang his/her head?
2. Does (name) bite his/her hands? (other body parts? Which? _____)
3. Does (name) hit his/her head (other body parts? Which?_____)
4. Does (name) pull his/her hair?
5. Does (name) gouge his/her eyes?
6. Does (name) pinch his/her arms? (other body parts? Which?_____)
7. Does (name) voluntarily fall or throw himself/herself against the wall, floor, etc?
8. Does (name) pick/scratch in his/her body cavities?
9. Does (name) scratch himself/herself?
10. Does (name) pick in his/her wounds?

Response Formats

- A. Does (name) pace or move around in a repetitive, patterned manner? For example, does he/she walk to and fro across a room or around the house or garden repeatedly?

B. Does (name) repeatedly operate light switches, taps, the toilet flush, and so on?

<p>a) HOW OFTEN DOES HE/SHE DO THIS?</p> <p>(0) never (1) 1-2 per week (2) 3-6 per week (3) 7-14 per week</p>	<p>b) HOW LONG DOES IT LAST?</p> <p>(1) less 60 secs (2) 1-3 mins (3) 4-9 mins</p>	<p>c) HOW REPETITIVE ARE THE MOVEMENTS?</p> <p>(1) usually one single movement (2) 2-3 movements in 10 sec (3) 4-9 movements in 10 sec</p>
<p>a) HOW OFTEN DOES HE/SHE DO THIS?</p> <p>(0) never (1) 1-2 per week (2) 3-6 per week (3) 7-14 per week (4) 15-29 per day (5) 30+ per day (6) almost constantly (7) 5-14 per day (8) no information (9) 15-29 per day</p>	<p>b) HOW LONG DOES IT LAST?</p> <p>(1) less 60 secs (2) 1-3 mins (3) 4-9 mins (4) 10-29 mins (5) 30 mins + (6) 1-3 mins (7) not applicable (8) 4-9 mins (9) 10-29 mins</p>	<p>c) HOW REPETITIVE ARE THE MOVEMENTS?</p> <p>(1) usually one single movement (2) 2-3 movements in 10 sec (3) 4-9 movements in 10 sec (4) 10+ movements in 10 sec (9) not applicable</p>
<p>(6) 30+ per day (7) almost constantly (x) no information</p>	<p>(5) 30 mins + (9) not applicable</p>	<p>(4) 10+ movements in 10 sec (9) not applicable</p>

C. Does (name) bang his/her head?

<p>a) HOW OFTEN DOES HE/SHE DO THIS?</p> <p>(0) never (1) 1-2 per week (2) 3-6 per week (3) 7-14 per week (4) 5-14 per day (5) 15-29 per day (6) 30+ per day (7) almost constantly (x) no information</p>	<p>b) HOW LONG DOES IT LAST?</p> <p>(1) less 60 secs (2) 1-3 mins (3) 4-9 mins (4) 10-29 mins (5) 30 mins + (9) not applicable</p>	<p>c) HOW REPETITIVE ARE THE MOVEMENTS?</p> <p>(1) usually one single movement (2) 2-3 movements in 10 sec (3) 4-9 movements in 10 sec (4) 10+ movements in 10 sec (9) not applicable</p>
<p>d) HOW INTENSELY DOES HE/SHE DO IT?</p> <p>(1) uses minimal effort (2) uses moderate effort (3) uses maximal effort</p>	<p>e) WHAT IS THE EXTENT OF THE DAMAGE CAUSED BY THIS BEHAVIOUR?</p> <p>(1) no physical damage (2) a bruise (3) skin breakdown (4) intensive injury (broken bones etc) (5) life threatening injury</p>	

Table 2

Pearson correlations between self-injurious and other stereotyped movements by sample

	SIB/SMO	SIB/SBM	SIB/TSM
Typical	.20	.16	.24
Intellectual Disability	.50*	.58*	.65*
Autism	.44*	.30*	.46*
Vision Impairment	.37*	.52*	.59*
Hearing Impairment	.12	.15	.16

Abbreviations: SIB = Self-injurious behaviour; SMO = Stereotyped manipulation of objects; SBM = Stereotyped body movements; TSM = Total stereotyped movements