Self-Injury and Stereotyped Behavior in Young Children with and without Developmental Delay

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Abstract

The stereotyped and self-injurious behavior (SIB) of individuals with intellectual disabilities and related developmental disabilities (I/DD) pose serious challenges that may cause severe physical damage or interfere with daily living activities. Although there has been work describing stereotypy and SIB in young children with I/DD, there is almost no direct comparative data between children with I/DD and typically developing children. The purpose of this study was to compare self-injury (SIB) and stereotyped behavior (STY) across approximate age and gender matched samples of young children (< 5 years of age) with and without developmental delay. The Repetitive Behavior Scale-Revised (RBS-R) was completed by parents/caregiver of n=49 children with developmental delays and n=52 typically developing children. Differences in frequency and severity ratings for SIB and stereotypy were tested between the two groups (developmental delay [DD], typically developing [TYP]) based on the RBS-R scores. Additional analysis was performed to test whether groups differed by age cohort or sex. SIB was reported for 60% of the DD sample and 26% of the TYP sample. STY was reported for 87% of the DD sample and 39% of the TYP sample. Using ANOVA, there was a significant main effect for SIB between samples (DD>TYP), F (1, 100) =51.40, p = .000, η^2 = .15. This sample showed clear differences between young children with developmental delays and their typically developing peers in the reported presence of self injury and stereotyped behavior. Going forward, the findings from this study provide among the first comparative estimates of stereotypy and SIB between age and gender matched children with and without developmental delay.

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Introduction

Self-injurious behavior is a serious behavior problem that affects a significant subgroup of children with intellectual and developmental disabilities and delays (I/DD). Although there are limited prevalence data, existing estimates of SIB among children with I/DD range from 19-32% of children with developmental delays or disabilities (MacLean & Dornbush, 2012; MacLean, Tervo, Hoch, Tervo, & Symons, 2010). Self-injury is defined as a behavior directed toward oneself that results in or has the potential to result in tissue damage (Baroff & Tate, 1966). Most commonly noted in children with developmental disabilities, some forms of SIB (e.g. head-banging) occur in typical developing children as well (Thelen, 1979). Beyond the damage to the individual that SIB causes, the behavior can severely affect the individual's community engagement as well as school learning and participation (Emerson, 2001). SIB can also cause stress and anxiety for the family, due to the possibility of a lifelong behavior problem, cost of treatment and the emotional stress of being with the individual who engages in SIB (Emerson, 2001; Hastings, 2002).

Given the severity of the problem, it is imperative to understand why some children with I/DD engage in SIB and others do not. It is not always clear what the motivation is for engaging in SIB, nor is it clear what the specific risk factors associated with the development of SIB are. In the following sections, the general models of SIB motivation and maintenance will be discussed, followed by a short review of the development of SIB. Risk factors associated with SIB will be examined and the rationale for the current study will be presented.

General Models of SIB Maintenance

Carr (1977) proposed five models of the maintenance of SIB including a learned operant-positively reinforced hypothesis, learned operant-negatively reinforced hypothesis, sensory stimulation hypothesis, an organic hypothesis, and a psychodynamic hypothesis. The five hypotheses are still the predominant theories in SIB research today. While some of the theories have little empirical evidence to support them, other theoretical models tend to have considerable empirical evidence supporting their account of different classes of variables with relevance for understanding SIB maintenance. Each of Carr's (1977) hypotheses will be briefly discussed.

Learned Operant SIB, Positively Reinforced. The learned operant model of SIB suggests that SIB is a learned operant behavior maintained by positive reinforcement mechanisms. From this perspective, SIB may be inadvertently positively reinforced (through access to social attention or tangible items), provided contingent on SIB (Carr, 1977). For example, an occupied caregiver may respond to a child hitting their head on the floor but otherwise ignore the child. Each time the child bangs his/her head and it is followed by caregiver attention, SIB may be inadvertently positively reinforced. Over time, caregiver attention will function as a positive reinforcer for the child's SIB.

Positive reinforcement is a well-researched and well-established model of one class of variables that can maintain SIB. There have been numerous studies that have found SIB to be maintained by positive reinforcement in the form of access to tangibles, or attention in both children and adults with I/DD (Iwata et al. 1994; Kurtz et al. 2003; Richman & Hagopian, 1999). One study by Kurtz and colleagues (2003), reported 38%

of individuals who engaged in SIB, had SIB maintained by some form of positive reinforcement. Similarly, Iwata et al. (1994) reported approximately 26% of SIB cases were maintained by positive reinforcement.

Learned Operant SIB, Negatively Reinforced. In the negative reinforcement model, SIB is conceived of as a negatively reinforced response (escape from an aversive stimulus). For example, if an aversive stimulus (such as an aversive task demand) is presented and a child engages in SIB, and the stimulus is removed or terminated contingent on SIB, it increases the probability of SIB in the presence of the aversive stimulus. Such a behavioral sequence would be evidence of a negative reinforcement relationship (Iwata et al, 1994).

Similar to the positively reinforced model, the negatively reinforced model is well researched in the literature. When functional analyses are conducted, negative reinforcement is a potential function that is examined. In a review of functional analyses in which the behavior is maintained by negative reinforcement, 35% take the form of escape from task demands (Iwata et al, 1994).

SIB as Sensory Stimulation. In the sensory stimulation model of SIB, it is assumed that there is an optimal level of stimulation necessary for a person. If sensory stimulation (tactile, visual, auditory) is not optimal, the child will engage in behaviors to increase (or decrease) sensory stimulation (in some cases this may involve SIB; Carr 1977). As one possible example of this notion, children reared in institutions and orphanages in which they are left alone for the majority of the day have been studied (Dennis & Najarian, 1957; Nijman, Campo, & Joost, 2002). A general finding has been that there are elevated rates of SIB and stereotypic behavior (STY) and that when environmental stimulation (interaction with others, toys, activity, and/or radio) is provided, aberrant behavior, including SIB, decreases. Impoverished environments have been often linked to challenging behaviors, including SIB, in those with developmental delay (Rojahn, Schroeder, & Hoch, 2008). Therefore, the sensory stimulation hypothesis has some evidence supporting it, and needs to be considered when evaluating SIB.

SIB is Organic or Biological. In the ‘SIB is organic’ model, SIB is considered to be the result of underlying pathophysiology including disrupted neurotransmitter function (Tunnicliff & Oliver, 2011). This perspective also includes the observation that some genetic syndromes have a high comorbidity with SIB such as Lesch-Nyhan syndrome (LNS; Lesch & Nyhan, 1964). The main neurotransmitters implicated in SIB include dopamine, serotonin, and endogenous opioids (Tunnicliff & Oliver, 2011). In rat models, depletion of dopamine has been found to induce SIB (Rojahn, Schroeder, & Hoch, 2008). In examination of the brains of those with LNS, there is a large depletion of dopamine as well as elevated serotonin levels (Lloyd et al, 1981). Serotonin reuptake inhibitors, and medications affecting serotonin levels, have been found to be effective in reducing SIB and aggression (Simon, Blubaugh & Pippidis, 1996). Endogenous opioids have been linked with a pain hypothesis (Rojahn, Schroeder & Hoch, 2008). The pain hypothesis involves a high pain tolerance, and those that engage in SIB are doing so in order to stimulate the receptors for pain (to which opioids bind). However, more recent research has determined that individuals who engage in SIB seem to experience increased pain reactivity (Courtemanche et al. 2012; Symons et al. 2009).

The 'SIB is organic' model of maintenance has multiple factors, such as pain and opioids, serotonin and genetic disorders, that are being researched. It is unclear yet if there is one primary biological phenomenon or if there is a multitude of factors that make up this model of SIB maintenance. Researchers have examined biological factors often when social contingencies are not evident in individuals with SIB (Matson, Hattier, Belva, & Matson, 2013). There is evidence supporting this hypothesis, and 'SIB as biological' should be considered when evaluating SIB.

Psychodynamic Theory of SIB. In the psychodynamic model of SIB maintenance, it is suggested that some people engage in SIB in order to establish "body reality" (Carr, 1977). A central tenet is that some people have difficulty understanding the self from the external world, and thus engage in SIB to gain secure body representation. There is little empirical evidence that exists to support this hypothesis, at least with regard to individuals with I/DD. However, Yates (2006) has studied SIB in regard to self-mutilation in adults from a low income community sample. In the context of self-mutilation, SIB has been found to relate to dissociation and somatization, which were a result of child abuse and neglect.

While Yates (2006) found SIB to relate to dissociation and somatization, the participants are different than those with I/DD. Therefore it is unclear how these results translate into those with I/DD and engaging in SIB. In summary, the psychodynamic theory of SIB needs further research in the I/DD population in order to be a plausible theory of SIB maintenance.

While it is evident that some of the models Carr (1977) proposed are supported in research there are other models that simply lack evidence. Learned operant (both positive and negative) are founded in research and are plausible functions of SIB maintenance (Iwata et al., 1994; Richman & Hagopian, 1999). Sensory stimulation as a model of SIB maintenance is supported in research, in regards to children raised in impoverished environments (Rojahn Schroeder & Hoch, 2008). The 'SIB is organic or biological' model has multiple hypotheses that may or may not be linked to one another. It is a model that is supported but still needs more research in order to determine exactly how neurotransmitters, pain, and genetics operate in maintaining SIB (Rojahn, Schroeder & Hoch, 2008; Tunniclif & Oliver, 2011). Lastly, the psychodynamic theory of SIB has little empirical evidence supporting it within the I/DD population. There are few studies, such as Yates (2006), in which there is evidence of this model but it is unclear and unfounded in the I/DD population.

Models of Early Development of SIB

Given the potential severity of the problem, it is imperative to understand how SIB develops. One version of the early development of SIB involves the relation between early motor stereotypy and proto-SIB, which will be discussed briefly. The learned operant model and neurochemical/pharmacological model of the development of SIB will also be discussed. There is also limited work investigating typically developing children and early motor behavior as it may relate to SIB.

Proto-SIB and Stereotypy. Proto-SIB is topographically similar to SIB in that it is behavior directed toward oneself, however it does not produce tissue damage. It has been found to be a possible precursor to the development of SIB, typically occurring at or before 24 months of age (Berkson, 2002; Richman & Lindauer, 2005). Similarly, stereotypic behavior has been found to also precede SIB (Symons et al. 2005). In a study assessing SIB, proto-SIB and stereotypy in young children, Richman and Lindauer (2005) found that at study entry 92% of participants were exhibiting proto-SIB and 75% were exhibiting stereotypic behaviors. Richman and Lindauer (2005) concluded that motor stereotypies (such as proto-SIB and stereotypic behavior) emerge in young children and persist in children with developmental delays. Further, many families find proto-SIB and stereotypy to be a problem behavior and severe enough to cause concern (Berkson, Tupa, Sherman, 2001).

Operant Development of SIB. In an operant model of early SIB development, repetitive behaviors are shaped and reinforced (both positively and negatively as described above), eventually leading to SIB (Carr, 1977; Furniss & Biswas, 2012; Iwata et al., 1994). Research has found that SIB can be developed and maintained through shaping (Carr, 1977; Lovaas & Simmons, 1969; Richman & Lindauer, 2005). Shaping is generally defined as progressively reinforcing behaviors, and in the case of SIB, reinforcing learned operant behaviors into SIB (Furniss & Biswas, 2012). Shaping may occur when SIB is first developing, for example a child may lightly tap their head which then gets positively reinforced (either through attention or access to tangibles, contingent on the behavior) into more severe head-slapping or head-hitting.

Just as in the operant maintenance models, reinforcement mechanisms are also thought to play a role in the development of SIB. If the reinforcement (attention or access to tangible) is contingent on SIB, SIB will likely increase (Carr, 1977). For example, if a child hits their head the floor and the mother provides attention for it, the child may begin to hit their head on the floor more often in order to receive attention. Similarly, if there is negative reinforcement for the behavior (escape from an aversive stimulus) a child will be more likely to engage in SIB when task demands are presented to get out of undesired tasks. Often operant shaping of behavior is inadvertent; however behaviors such as stereotypy may become controlled by the same variables as more severe problem behaviors, and can therefore be shaped into SIB (Richman & Lindauer, 2005; Rojahn, Schroeder, & Hoch, 2008). For instance, a child may flap their hands rapidly many times in a row and then receive positive reinforcement when engaging in the behavior (given a favorite toy in order to occupy their hands), at one point the parent may not give the toy and the child then may try another method to gain the parent's attention to gain access to the toy. This could involve the child hitting their head with their hands, following which the parent then gives in because they do not want the child to hurt themselves. In that moment SIB became controlled by the same variable that STY is controlled by, access to tangibles and parent attention. While all of the models of early SIB development are lacking in strong conclusive empirical evidence, the operant development of SIB is arguably the most well researched model of SIB development. SIB has been found to develop through positive and negative reinforcement as well as be maintained by it (Oliver, Hall & Murphy, 2005). However, many studies on the development of SIB have samples of children that are already engaging in SIB. This limits the amount of understanding on the development of SIB simply because researchers are using children already engaging SIB.

Neurochemical/Pharmacological. Due to the severity of some children's engagement in SIB some hypotheses about its development have included neurochemical variables related to pain (Symons & Thompson, 1997). One hypothesis has two foci: the dysesthesia hypothesis (a central or peripheral injury to the nervous system resulting in abnormal sensations) and the anesthesia hypothesis (diminished pain perception of harmful stimuli due to an injury to the nervous system) (Rojahn, Schroeder, & Hoch, 2008). Both the dysestheisa hypothesis and the anesthesia hypothesis have research which supports them, however it still remains unclear as to whether self-injury is the cause or the consequence of altered sensations or pain (Symons, 2010).

Brain neurochemistry has also been implicated in some models of SIB development (Courtemanche, et al. 2012). In a study using rat models by Muehlmann, et al (2012) the results suggested that pemoline (a drug used to treat attention deficit hyperactivity disorder) produced changes in the limbic, hypothalamic and striatal structures. The authors suggested that brain targets need to be investigated more thoroughly due to the unknown role of limbic regulation or dysregulation in relation to the emergence of SIB.

The study of brain neurochemistry has not been well researched in regards to the development of SIB, instead various drugs have been used to decrease SIB. While there are some conventional hypotheses, such as altered brain neurochemistry, altered pain perception and the pemoline model, in regard to the role of neurochemical/pharmacological variables in the development of SIB, the research is not conclusive and more studies are needed.

Typical Development and SIB. Typically developing children engage in early rhythmic motor behaviors (Sallustro & Atwell, 1978). Researchers began to question whether these rhythmic motor behaviors were related to stereotypy and SIB in children with developmental delay. Guess and Carr (1991) proposed that motor stereotypies are characteristic of most children. Stereotypy and SIB were viewed as adaptations to under or over stimulating environments for all children, although they appear later in children with I/DD (Guess & Carr, 1991).

There has been a small number of research studies conducted to understand SIB in typically developing children. Typically developing children have been documented to engage in motor stereotypies such as body rocking, head-rolling and toe-sucking (Kravitz & Boehm, 1971; MacLean et al. 1991). These motor stereotypies are repetitive, rhythmical, and seemingly without purpose (Symons, Sperry, Dropik & Bodfish, 2005). Research suggests that early rhythmical/motor stereotypies are part of the developmental pathway for the maturation of skilled motor behaviors and/or a sign of neuromuscular development (Lourie, 1949; Thelen, 1979). One study reported 15% of a sample of typical babies engaged in head-banging (de Lissovoy, 1961). However, only a handful of studies have examined SIB in typical children after the first year or two of life. Smith and Van Houten (1996) is one of few studies that have focused on older children (3-7 years). In this study they found that typical children engaged in stereotypic behavior at the same rate/frequency or more than children with developmental delay. The finding that both typical and developmentally delayed children engage in STY at the same frequency indicates that we need to not only examine STY in children with developmental delay but also typical children, due to the frequency of the occurrence of SIB in a variety of children regardless of developmental delay.

Current research focuses primarily on children with developmental delay because of the prevalence and severity of SIB/STY in that population. However, it is necessary to understand if SIB/STY in children with developmental delay is similar to rhythmical motor behaviors found in typically developing children, and current research is not conclusive. The research about SIB/STY in typical children, birth through 5 years, is lacking. There are few studies that examine typical children in regards to SIB, and those studies use varying approaches which makes it difficult to reach a general consensus. Therefore, it is still unclear how SIB develops in typical developing children and how it translates to children with I/DD.

Prevalence and Risk factors for SIB

In addition to the general models of SIB and its development, there is an existing body of research that may be characterized very broadly as epidemiological and concerned with prevalence estimates of SIB, correlates of SIB, and risk factors for its development. In the following sections the relationship between SIB and the severity of disability, SIB and communication deficits, SIB and gender, and SIB and age will be briefly discussed.

Severity of Disability and SIB. To further understand the development of SIB the severity of intellectual disability has been examined. Studies have found more severely impaired individuals with an intellectual disability often have more severe SIB (McClintock, Hall & Oliver, 2003; Schroeder, Schroeder, Smith & Dalldorf, 1978). In McClintock, Hall and Oliver's (2003) meta-analysis, the researchers point out that the results, relating severity of intellectual disability with severity of SIB, need to be viewed cautiously, as there was a wide range of methodologies used in the studies reviewed as well as a small sample of studies to gather from. Individuals with a more severe form of Autism Spectrum Disorder (ASD) have been found to engage in more severe SIB, although having the diagnosis of ASD does not necessarily increase the chances of SIB (Bodfish et al. 2000). Only a small sample of adults was included, however those adults were all from one care facility. Additionally, a lack of overall functional skills have been found to have a relationship with SIB, most specifically lower daily living skills and poorer communication skills have an increased likelihood of SIB (Emerson et al. 2001). A limitation of this study included that an interview with an informant was used to gather data about each participant in the study, instead of a measurable assessment about the participant's level of disability. While these are just a few of the studies that exist on the topic, as a whole, this research is not conclusive due to a wide range of methodological issues.

Communication Deficits. Poor communication skills, specifically language, have been seen to have some relation to the severity of disability, SIB and stereotypy. Severe language deficits were found to be related to the presence of SIB (Schroeder et al. 1978). A meta-analysis by McClintock, Hall and Oliver (2003) found that many individuals with severe intellectual disabilities have poorer communication skills, both expressive and receptive language, than those with a more mild form of intellectual disability. Communication deficits link well with the operant model of maintenance of SIB. Functional communication training (FCT) has been used with children who engage in SIB, maintained by social positive reinforcement (Moore, Gilles, McComas & Symons, 2010; Worsdell et al. 2000). Once the child had been taught to effectively and functionally communicate SIB was found to decrease. In this study there were no data available to draw a relationship between language deficits and stereotypy, which is interesting considering that there are theories suggesting stereotypy occurs with more frequency when there is a lack of functional language (McClintock, Hall & Oliver, 2003). Further study is needed to understand if language and communication deficits need to be considered risk factors.

Gender. There have been conflicting results related to gender as a risk factor for SIB/STY. In one study, for example, males were found to engage in SIB and STY more frequently than females (Hattier, Matson, Tureck, & Horovitz, 2011). The results were limited in that the participants had co-morbid diagnoses of ID and ASD and were all from one state-run facility. However, other studies have found a higher proportion of females engaging in SIB and doing so more severely than males (Cooper et al. 2009; Deb, Thomas & Bright, 2001). Limitations of these studies included a low number of subjects included in the database that was recruited from, and a subjective interview to determine qualifications of a behavior disorder. There are other studies in which no relationship between gender and SIB was found (MacLean et al. 2010; Tenneij & Koot, 2008). Due to the wide variation in results, there is no current consensus about gender being a risk factor for SIB. Additional study is also needed to understand if a gender/SIB relationship appears in typically developing children.

Age. Age has been examined as a risk factor for SIB. Large-scale studies have found negligible correlations between age and the presence of SIB (Cooper, 2009; Emerson, 2001). Chadwick, Kusel and Cuddy (2008) also found no relationship between age and the presence of SIB in their study with children and young adults with genetic disorders. Berkson (2002) found that SIB, in the form of head-hitting and head-banging, appear to be stable across the age bands of 12-36 months, but SIB in the form of eye-poking or eye-pressing tend to abate with age. Further, Esbensen, Seltzer, Lam and Bodfish (2009) found that SIB decreased as age increased in their sample of children and adults with ASD. Rojahn, Schroeder and Hoch (2008) reviewed studies of age as a risk factor for SIB and found that many studies had an interaction between age and level of intellectual disability, which predicted engagement in SIB. The interaction pattern described by Rojahn, Schroeder and Hoch (2008) has a low prevalence in early childhood, increased rate of SIB during adolescence, and then decrease again in adulthood. More conclusive research is needed to determine if any relationship exists between SIB and age, and if so is it consistent with past research indicating SIB dissipates as a child ages.

Rationale for Current Study

Given the importance of the problem, there still seems to be a relatively limited body of work about what is known about the early development of SIB in young children at risk for I/DD. There is good reason to consider operant learning variables as relevant

(Carr, 1977; Iwata et al. 1994; Kurtz, 2003) as well as other factors including severity of the developmental delay (McClintock, Hall & Oliver, 2003), language problems (Emerson, et al. 2001; Schroeder et al. 1978), gender (Cooper et al. 2009; MacLean et al. 2010), and age (Berkson, 2002; Esbensen, Seltzer, Lam and Bodfish, 2009). Differences in study designs and methodology make it difficult to compare across all of the studies and reach a solid conclusion about early SIB development. One of the limitations is that there is often no direct comparison between children with and without developmental delay using the same measurement tool. A direct comparison between typically developing children and children with delayed development would be helpful in understanding the development of SIB in children, regardless of disability or not. Further, it would allow the relationship between SIB/ STY and risk factors to become more evident. The purpose of this study was to determine if there were differences in parent-reported frequency of SIB and STY between a community cohort sample of typically developing children and an age/gender matched clinical sample referred for developmental delay concerns. Subsequent goals were to determine if (a) age was correlated with SIB/STY within and/or between groups, (b) if there were gender differences associated with SIB/STY within and/or between groups, and (c) if SIB/STY were related to developmental level in the developmental delay group.

Method

This study was approved by the University of Minnesota's Institutional Review Board and informed consent was obtained for all participants. Two convenience samples were recruited from two sources/sites. The 'at risk for developmental delay' (DD) sample was formed by consecutive enrollment of families through a developmental behavioral pediatrics specialty clinic. Upon clinic enrollment, families completed an intake packet to obtain demographic and medical history information. The Repetitive Behavior Scale-Revised (RBS-R, described below) was included in the packets. The typical development (TYP) sample was formed by providing university childcare center staff RBS-R packets to distribute to all parents with a child enrolled at the center at the time of the study. Parents filled out and returned the RBS-R via U.S. Mail. Individuals were excluded if the child had an Individual Family Service Plan (IFSP; which denotes services being provided for concerns related to development or related risk issues). There was a 34% response return rate for the TYP sample.

There were 49 children in the DD final sample and 52 children in TYP sample. The mean age of DD sample was 37.5 months (*SD*=13.2) and the mean age for the TYP sample was 37.1 months (*SD*=14.6). The DD sample was predominantly male (81.6%) and between the ages of 25-48 months [28.6% in each age cohort (25-36 and 37-48 months)]. The TYP sample was also predominantly male (59.2%) and between the ages of 25-36 months (27.7%). Four children from the TYP sample were removed from analyses because gender and/or age were not provided by the parent survey resulting in a final sample size of 48 for the TYP sample. The two samples were subsequently balanced by age (F (1, 96) =22.54, p = .735, η^2 = .001; see Table 1).

Measures

Repetitive Behavior Scale-Revised (RBS-R). The RBS-R was chosen for the study because it is used in clinical settings and is an industry standard in measuring repetitive behavior in developmental disability and related research (Mirenda, et al. 2010). The RBS-R is comprised of six subscales: stereotyped behavior, self-injurious behavior, compulsive behavior, ritualistic behavior, sameness behavior, and restricted behavior (Bodfish, Symons, Parker, & Lewis, 2000). For the purpose of the study, the self-injurious behavior (SIB) and stereotyped behavior (STY) subscales were used. The stereotyped behavior subscale consists of six questions regarding apparently purposeless movements or actions that are repeated in a similar manner (ex. body rocking, flaps hands, spins objects). The self-injurious behavior subscale consists of eight questions regarding actions that have the potential to cause redness or bruising to the body, and that are repeated in a similar manner (ex. bangs head on the floor, bites hand, picks at the skin). All subscale items are rated on a scale of zero to three; zero=behavior does not occur, one=behavior occurs and is a mild problem, two=behavior occurs and is a moderate problem, three=behavior occurs and is a severe problem. Prior research with comparable groups has yielded scores that appear to be reliable and valid (Lam & Aman, 2007).

Child Development Inventory (CDI). The CDI contains 270 questions in which parent's assess a child's development, using "yes" "no" questions (Ireton, 1992). The CDI is used to evaluate children 15 months through 6 years old; one of the subscales (general development) contains items that are age-discriminating. The developmental scales measure social, self-help, gross motor, fine motor, expressive language, language comprehension, letters, numbers, and general development. The complete report indicates areas of delay and concern as well as strengths in relation to the child's chronological age (Tervo, 2011). The CDI's developmental age estimate has been found in past research to have a strong correlation with other developmental testing (Petersen, Kube, Witaker, Graff, & Palmer, 2009). In the present study the CDI was used to examine the developmental level, expressive language, and language comprehension of participants in the DD sample and the relationship to SIB and STY.

Data Analysis

Descriptive statistics were calculated resulting in estimates to compare parent reported SIB and STY between groups. Two different analysis of variance (ANOVA) models were run (SIB, STY) to determine the relationship between group (DD, TD) and SIB/STY. An ANCOVA model was also created for each analysis to test for age as a covariate, the age term was not significant and the simpler model was used. Correlations were run to determine if general development, expressive language, and language comprehension were correlated with SIB/STY within the DD group. All statistical analyses were conducted using the total subscale scores (the sum of the number of items endorsed plus the rating for each item).

Results

SIB, STY Frequency and Severity

Descriptive statistics were run to examine the frequency of SIB and STY in both samples. SIB was reported for 60% of the DD sample and 26% of the TYP sample (parent reported a score of 1 or over to at least one of the SIB items, indicating at least the presence of SIB). The mean severity of SIB in the DD sample was 4.10 (0-14) and 1.41 (0-3) in the TYP sample. STY was reported for 87% of the DD sample and 39% of the

TYP sample (parent reported a score of 1 or over to at least one of the STY items, indicating at least the presence of STY). The mean severity of STY in the DD sample was 5.19 (0-14) and 1.71 (0-5) in the TYP sample. SIB and STY were significantly correlated with each other (r=.49, p<.000). The overall number of items endorsed on all of the RBS-R subscales for the DD sample averaged 13.98 (2-41) and 5.41 (0-20) for the TYP sample.

SIB

Using ANOVA, there was a significant main effect for SIB between samples (DD>TYP), F (1, 100) =51.40, p = .000, η^2 = .15. Incorporating previous research age bands, ages of participants were divided into four age cohorts for analyses (13 to 24 months, 25-36 months, 37 to 48 months, and over 49 months; Davies & Oliver, 2012). There was no significant interaction found across age cohorts or gender (p>.541, η^2< .02). Neither age by group nor gender by group were significant (p>.452, η^2< .03). The most common topography of SIB for the DD sample was “hits self against surface or object,” which was endorsed 19 times. The most common topography of SIB for the TYP sample was “rubs or scratches self,” which was endorsed 5 times.

STY

A separate ANOVA revealed a significant main effect for STY between samples (DD>TYP), F (1, 100) =18.11, p = .000, η^2 = .34. There was a significant age by group interaction, F (4, 97) =.53, p < .012, η^2 = .12. Gender was not significant, F (1, 97) =.46, p > .0496, η^2 = .01. Post hoc power for the STY sample by age interaction was .62 whereas for the SIB model group by age interaction it was .13. This appeared to be driven by the relatively low incidence of SIB in the TYP sample (minimum 2) whereas in STY the minimum was at least 4. The most common topography of STY for the DD sample was “sensory,” which was endorsed 32 times. The most common topography of STY for the DD sample was endorsed 7 times each in three categories, “locomotion, object usage, and sensory.”

Correlates with SIB within Developmental Delay Group

Pearson correlations were run to determine whether SIB and STY were correlated with general development and language abilities based on the CDI. SIB was not significantly correlated with general development (r=.096, p>.519), expressive language (r=.084, p>.572) or language comprehension (r=.016, p>.913). STY was not significantly correlated with general development (r=.237, p>.109), expressive language (r=.358, p>.013) or language comprehension (r=.312, p>.033).

Discussion

The purpose of the study was to contribute to the relatively limited body of work about what is known about the early development and maintenance of SIB in young children at risk for I/DD. The primary focus of the study was to examine the frequency and severity of parent-reported SIB and STY in typical children to compare with an approximate age/gender matched sample at risk for I/DD. Other factors including severity of the delay, language problems, gender, and age were examined within the I/DD group based on previous research identifying these as risk factors.

The results of the current study found both SIB and STY were reported more frequently and with a greater severity in the DD sample compared to the TYP sample.

These results extend the minimal research available comparing typically developing children with children with developmental delays using the same measurement tool (Smith & Van Houten, 1996). Smith and Van Houten contended that those with I/DD spent more time than their matched peers on self-stimulatory behavior, which is consistent with Thelen's (1980) hypothesis. The results of the current study also provide evidence supporting Thelen (1980) and Smith and Van Houten (1996) in that those at risk for I/DD were engaging in SIB and STY significantly more frequently than a non-risk group. The most common topography of SIB for the DD sample was "hits self against surface or object," while the most common topography of SIB for the TYP sample was "rubs or scratches self."

There were no differences in reported SIB by gender for either sample. This could have been because our sample did not include a large number of females in the study and of the females included there were a small number of females reported to engage in any SIB (n=13) across groups. It could be said that SIB occurred at too low of rates to be analyzed for the risk factor of gender. The results of having no age correlation with SIB is similar to past research which found negligible or no correlation (Chadwick, Kusel and Cuddy 2008; Cooper, 2009; Emerson, 2001). A post hoc examination of power and the interaction effects indicate there were not enough typical children sampled to analyze group by age interactions, as reflected in the post hoc power and number of children per cell. On the other hand, STY showed significant interaction effects for age cohort by sample and gender. Contrary to this study's results, Hattier, Matson, Tureck, and Horovitz (2011) found females engaging in STY more frequently than males.

Neither SIB nor STY showed significant correlations with any of CDI correlates (general development, language comprehension, or expressive language). This is consistent with more recent research (MacLean et al., 2010), but conflicts with past research in which a meta-analysis concluded lower functional levels to be related to the presence of SIB (McClintock, Hall & Oliver, 2003). Further, past research has also correlated lower language skills with SIB (Schroeder et al. 1978). One reason that this may not have been found in the current study is that the DD sample may not have varied on the severity of the disability to the same degree of previous older samples which tended to be based on severe intellectual impairments, thereby affecting whether development and language were factors.

There are limitations of this study. SIB and STY were measured indirectly by parent report and so some parents may have filled out the RBS-R incorrectly or misread the instructions. Two parents also noted on their form that their child displayed the behavior but it was not a problem. Another limitation includes that the sample was non-random and so may not be representative, which limits the generality of the findings and therefore conclusions are specific to the study samples. The response rate for the TYP sample was 33.5% and so there is always the possibility of bias. Collectively, these limitations lead to the recommendation that the findings be considered preliminary and descriptive.

In closing, the results suggest a differentiation in SIB/STY frequency, severity and topography between typical children and those at risk for I/DD. Age and gender were not identified as correlates for SIB, as some previous research suggested. Further, general development and language skills were not identified as risk factors for SIB/STY.

Tables and Figures

Table 1

Samples Matched on Age

Group	Mean	Standard Error	95% Confidence Interval		P value
			Lower Bound	Upper Bound	
Developmental Delay	37.53	1.99	33.57	41.49	.735
Typical Development	36.57	1.99	32.61	40.53	.735

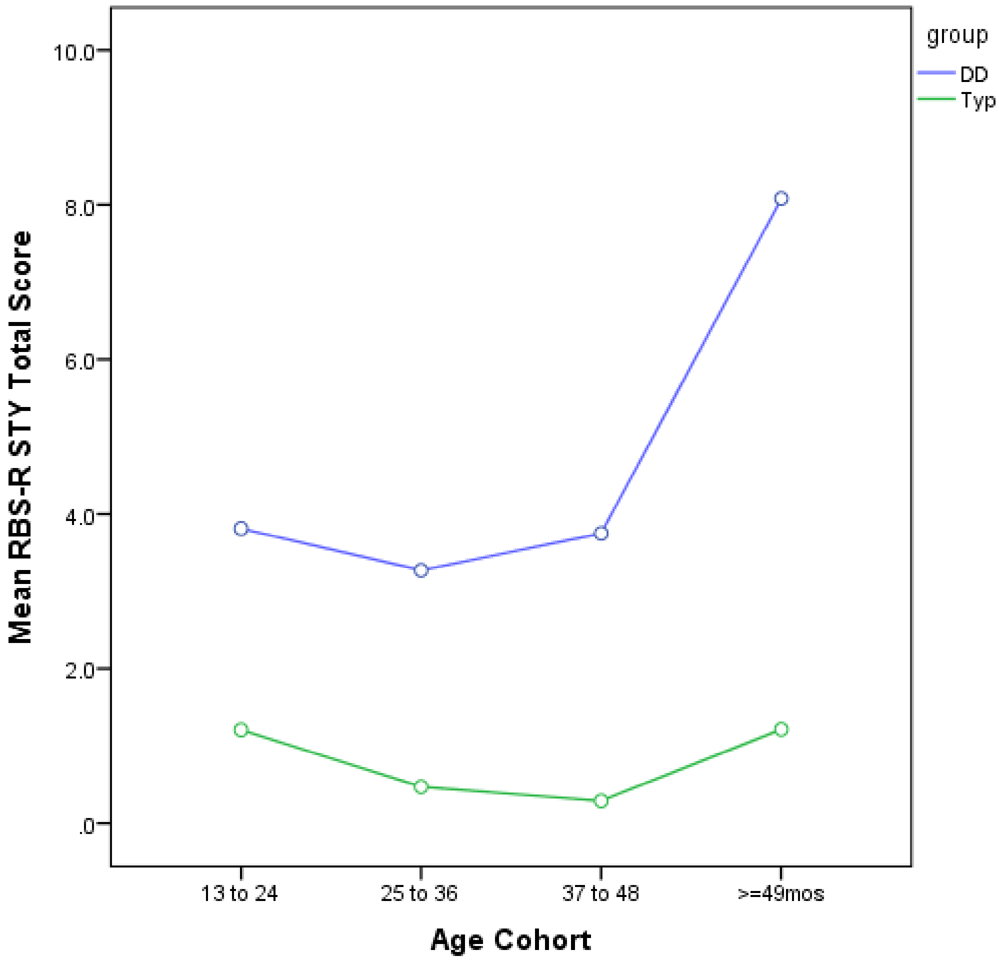

Figure 1. Estimated marginal means of STY by group and age cohort. The typical group had a lower mean of STY across age cohorts compared to the DD group (F(1,100)=18.11, p = .000, η^2 =.34).

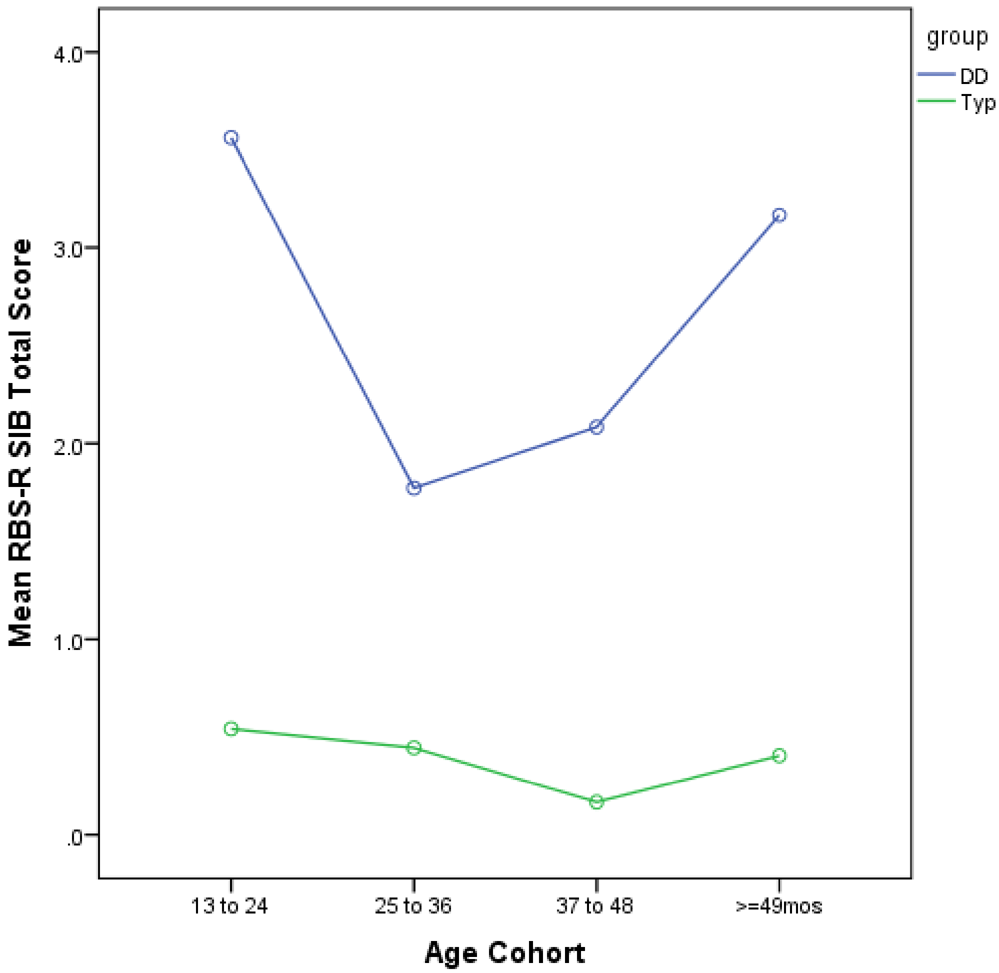

Figure 2. Estimated marginal means of SIB by group and age cohort. Typical group had a lower mean of SIB across age cohorts compared to the DD group ($F(1,100)=51.40$, $p=.000$, $\eta^2=.15$).

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