Self-talk during Planning and Problem Solving in Young Children with
Specific Language Impairment

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ABSTRACT

Self-talk is important for executive functioning, particularly planning and problem solving, and self-regulation in children. Children with lower language abilities have been shown to have impairments in planning and problem solving (Fernyhough & Fradley, 2005). As language development in general is delayed or disordered in children with Specific Language Impairment (SLI), it was considered likely that their self-talk may also be impaired, with negative consequences for their planning, problem solving and self-regulation. However, research on the self-talk of children with SLI is scarce. Thus, the aim of this thesis was to examine the self-talk of children with SLI and to design and implement a self-talk training programme aimed at improving the self-talk of children with SLI. It was expected that any improvements in self-talk during planning and problem solving would lead to a concomitant increase in the planning and problem solving performance of children with SLI.

The first study reported in this thesis examined the self-talk of young children (aged 4-7 years) with SLI \( n=91 \) and age-matched typically developing children \( n=81 \) during planning and problem solving using the Tower of London (TOL), which is a well-known executive functioning task that taps into planning and problem solving. We also looked at a subset of children with SLI that has received very little attention, that is, children with SLI with hyperactive and inattentive behaviours. There were \( n=31 \) and \( n=11 \) children with hyperactive and inattentive behaviours in the SLI and typically developing group respectively. We compared their self-talk and TOL performance to children with SLI without hyperactive and inattentive behaviours and typically developing children with hyperactive and inattentive behaviours. Results showed that the children with SLI were not only delayed in their self-talk development and internalization, but were also significantly impaired in terms of their planning and
problem solving performance relative to their typically developing peers. In addition, children with hyperactive and inattentive behaviours performed more poorly on the TOL than those without hyperactive and inattentive behaviours, but only in the SLI group. Children with SLI and hyperactive and inattentive behaviours were also found to have more private speech than children without hyperactive and inattentive behaviours.

Having established a delay in the self-talk of children with SLI, we then designed a self-talk training intervention programme aimed at improving the self-talk of these children. The self-talk training programme: Talk to Think, is a play-based self-talk training programme based on Vygotskian principles of sensitive scaffolding during planning and problem solving. The self-talk training programme is grounded on the principles of interpersonal collaboration between the experimenter and children, using play-based activities (Lego building) to enhance and develop self-talk. Verbal prompts and leading questions were used to encourage children’s self-talk production and tasks that provide an appropriate degree of challenge and are likely to maintain the interest level of the children were selected. Children were divided into groups of three and had ten, 30 minutes sessions of the intervention over five weeks with the experimenter. Parental and teacher involvement were strongly encouraged to ensure continuity and reinforcement of the self-talk training at home and in the classroom.

The effectiveness of this self-talk training programme for increasing self-talk and subsequently improving the planning and problem solving performance of children with SLI was assessed using a wait-list intervention design. The results demonstrated that the training was effective in terms of increasing the amount of self-talk overall in children with SLI, particularly their private speech. As predicted, there was a subsequent increase in the planning and problem solving performance of children with SLI after self-talk training, with the TOL scores of children with SLI no longer significantly different from those of their typically developing peers. This indicates that
self-talk training has the potential to enhance self-talk in young children with SLI and improve their planning and problem solving and possibly their executive functioning more broadly.

The findings from the studies reported in this thesis have a number of important clinical and theoretical implications. These are discussed in the General Discussion along with limitations and directions for future research.

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CHAPTER 4. Effectiveness of Self-talk Training for Planning and Problem Solving in Children with Specific Language Impairment

Abstract
Introduction
The Present Study
Method
Participants
Tasks and Procedures
Inter rater reliability
Intervention Programme: Self-talk Training
Results
Group Comparisons on Matching Variables
Effect of Self-talk Training on the Self-talk of Children with SLI
Effect of Self-talk Training on TOL Performance
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CHAPTER 5. General Discussion

Self-talk in Children with SLI Compared to Their Typically Developing Peers
Talk to Think Programme, Self-talk Training Effectiveness Study
Theoretical Considerations
Clinical Implications of Findings
Limitations
Statement of Contribution

The two studies reported in this thesis were designed by the candidate in collaboration with her supervisors, Dr. Donna Bayliss and Dr. Janet Fletcher. The Self-talk Training manual was designed by the candidate in collaboration with Dr. Janet Fletcher. All participants were recruited by the candidate. Eighty percent of the test data was collected by the candidate and another twenty percent by a research assistant. The intervention programme was carried out in full by the candidate. All self-talk coding, data entry, analysis and scoring were performed by the candidate. Twenty five percent of the video recordings were randomly chosen and transcribed by a postgraduate student in psychology to ensure inter-rater reliability. The manuscripts and Self-talk Training manual were written by the candidate, with revisions made in accordance with suggestions from her supervisors and anonymous reviewers.

Safiyyah Abdul Aziz (Candidate) Date

Donna Bayliss (Co-Supervisor) Date

Janet Fletcher (Co-Supervisor) Date
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May God bless each of you.
Language deficits have been linked to poorer executive functioning and self-regulation in children (Fernyhough & Fradley, 2005), which has often been attributed to a lack of or ineffective self-talk (Bishop & Norbury, 2005). Children with Specific Language Impairment (SLI) have language deficits that are likely to cause a barrier to self-talk development, which may underlie many of the documented deficits in cognitive and executive functioning in these children. However, research examining the self-talk of children with SLI is scarce. This thesis comprises two large-scale studies that were conducted to examine the self-talk of children with SLI during planning and problem solving and to evaluate the effectiveness of a novel self-talk training programme, designed as part of this thesis, to increase the self-talk and enhance the planning and problem solving of children with SLI.

The central findings of this thesis are that children with SLI are delayed in their self-talk development and that this limitation leads to a significant impairment in their planning and problem solving, which can be overcome with self-talk training. Chapters 2 and 4 report the studies that document these findings. Both studies reported in this thesis use a large sample of both typically developing children and children with SLI. Studies of this magnitude, involving the implementation of an intervention programme and the coding of speech data at multiple time-points, in a special population of children with SLI are rare. However, as a result, this thesis makes a significant contribution to our current knowledge on the self-talk of children with SLI because it allows for a comprehensive examination of self-talk across the first three years of schooling (Kindergarten, Preprimary and Year 1) and helps us to definitively answer the question of whether children with SLI experience a delay in self-talk and whether this delay can be ameliorated with self-talk training.
This thesis is presented as a collection of papers in a format suitable for publication. At the time of submission, Chapter 2 and 4 have been submitted for publication. Chapter 3 describes the self-talk training programme that was designed and implemented as part of this thesis and has been prepared for publication at the Australian Council for Educational Research (ACER). Chapter 1 presents a review of the literature that forms the basis of the current investigations; the theories of Piaget and Vygotsky are discussed in relation to the developmental origin and stages of self-talk and its role in executive functioning, particularly planning and problem solving, to provide a current overview of self-talk development in young children. Research examining self-talk in special populations is outlined and a critical review of self-talk intervention programmes is provided. Chapter 5 summarizes the results, the clinical and theoretical implications of these findings, and provides directions for future research.


Chapter 1

General Introduction and Literature Review
A 5-year-old girl during play with Lego building blocks:

“Let’s build a house. I am going to make a big house. This here… Blue bit here… I
need this… Woo…There you go! One here… Maybe not… Hmmm… Change this with
this, good…”

This overt speech is referred to as self-talk or private speech and is typically
observed in young children during play, planning and problem solving. Self-talk is
usually overt in young children. In older children, adolescents and adults self-talk
usually takes the form of inner speech or inaudible muttering, however occasionally,
particularly when alone or when faced with challenging moments, overt full-volume
speech is used. Self-talk, previously termed egocentric speech or speech for self by
Piaget and Vygotsky, refers to speech that is used for the benefit of oneself. Self-talk
researchers have been intrigued by the impact of this verbal mediation on children’s
cognition and their executive functioning, especially their ability to plan and problem
solve (Winsler, 2009).

This chapter presents a review of the literature that underpins the current
investigations; the theories of Piaget and Vygotsky are discussed in relation to the
developmental origins and stages of self-talk and its role in executive functioning,
particularly planning and problem solving, to provide a current overview of self-talk in
young children. Self-talk in special populations as well as self-talk intervention
programmes are also outlined.
1.1 Theoretical Background of Piaget and Vygotsky

Formal interest in children’s self-talk began when Piaget wrote about egocentric speech in his 1923 book, *The Language and Thought of the Child* (Piaget, 1977). Egocentric speech, in contrast to socialized speech, refers to speech in which “the child speaks partly about himself and does not attempt to place himself at the point of view of the hearer… He feels no desire to influence his hearer nor to tell him anything” (Piaget, 1923/1926, p.9). Although Piaget believed that speech did not have a cognitive function separate from its social function, he did consider language (not egocentric speech) critical to rational thought. He argued that language is used to solidify concepts as a child matures, and that the child uses social speech to communicate their thoughts to others. Piaget’s opinion at that time was that egocentric speech is a less mature form of social speech that a child will outgrow with increased competence in social interaction and interpersonal communication (Piaget, 1977).

Born in the same year as Piaget, Lev Vygotsky strongly disagreed with Piaget’s view of egocentric speech. He conducted a series of systematic studies and observations in regard to children’s self-talk. From his experiments, Vygotsky found that children used their speech for self (egocentric speech as Piaget termed it) initially to describe their activities and later on, for planning and self-regulation. He also observed that children’s self-regulatory speech increased as the task increased in difficulty. Vygotsky also disagreed with Piaget that egocentric speech will be outgrown and replaced with social interaction. Vygotsky proposed that speech has two roles, one for communication with others and another for the benefit of the self, and that these develop in parallel (Vygotsky, 1934, 1978, 1987). This differed from Piaget’s view in that rather than egocentric speech being replaced by more mature social language, self-talk is actually a product of the social interaction of the child with significant others. According to Vygotsky, children develop their speech for self through the internalization of verbal
regulation that is provided by their parents, teachers or older siblings. In the early years of childhood when the child is about 3-5 years old, they start using self-talk out loud to guide their own thoughts and actions. Vygotsky explained that speech for self is used by the child for self-regulation, planning and problem solving. As children age, this overt self-talk gradually gets internalized to form verbal thought.

In response to Vygotsky’s critical remarks on his description of egocentric speech in his books *The Language and Thought of the Child* and *Judgment and Reasoning in the Child*, Piaget wrote a commentary (Piaget, 1962). With regard to egocentric speech, Piaget agreed with Vygotsky on three main points: that egocentric speech needed to be further explored and was more complex than he initially conceptualized in 1923; that egocentric speech increases during challenging tasks, and that egocentric speech has a function in logical thought. However, Piaget contended that many researchers, including Vygotsky, had not fully understood the concept of egocentrism and egocentric speech in the way he intended. According to Piaget, an egocentric child is not capable of taking the view of other people, especially when he/she is deeply engaged in a task and during individual play. He contended that egocentric speech is not only limited to private speech that a child uses overtly, but covers all speech that is based solely on the child’s point of view with no considerations of another’s point of view. Thus, egocentric speech can be directed to another person as well as directed to oneself. Therefore, although both scholars agreed that language, and in particular, self-talk, is used for thought and to guide children’s behaviour, they disagreed about the way in which self-talk develops and the mechanism by which it is related to behaviour.
1.2 Developmental Origins

According to Vygotsky, self-talk develops through social interactions during a joint activity such as play or formal teaching. The interactional partner of the child (usually a parent, teacher or older sibling) uses their language to regulate the behaviour of the child. This dialogue is then internalized by the child and used as self-regulatory language by the child for their own thoughts and actions (Fernyhough & Fradley, 2005; Fernyhough & Russell, 1997). Therefore, as children develop, they build a repertoire of words to form their own self-talk. As social interaction increases, the child adds to their existing self-talk language to build more mature self-talk.

Therefore, from the Vygotskian perspective, there is a developmental shift from verbal mediation by others to verbal mediation by the self. This developmental pattern has been shown at a microdevelopmental level in a study by Winsler, Diaz and Montero (1997b) who looked at verbal scaffolding by adults in joint problem solving activities with children. Their study showed that there was an increase in the use of self-talk and better problem solving performance in children who were provided with verbal scaffolding by an adult compared to children who did not receive verbal scaffolding. Other studies have also confirmed the role of regulation by others in developing children’s self-talk, allowing them to progress to self-regulation (Diaz, Winsler, Atencio, & Harbers, 1992; Landry, Miller-Loncar, Smith, & Swank, 2002; Winsler, Diaz, McCarthy, Atencio, & Adams Chabay, 1999)

1.2.1 Age-Related Changes

All self-talk serves the same function; to facilitate cognition, executive functioning and self-regulation, however there are a number of different types of self-talk that can be observed. Self-talk is divided into overt and covert speech. Overt speech consists of social and private speech while covert speech consists of inaudible
muttering, silent lip movements, inner speech and silent verbal thought. Social speech is typically full volume and is addressed to a conversational partner this is indicated by eye or physical contact, using the person’s name and/or engaging in dialogue that is task relevant. Private speech is typically full or lower volume speech but is not addressed to a conversational partner. Rather, it is addressed to the child him/herself with no indication of social interaction if another person is present. Inaudible muttering and silent lip movements are mouth movements usually with some low volume vocalization that cannot be captured by an observer. Inner speech and silent verbal thought cannot be observed behaviourally. All covert speech is addressed to the self (Sturn & Johnston, 1999).

Vygotsky suggested that besides being socially mediated, the pattern of self-talk development in children is curvilinear, an inverted ‘U’ shape. Overt self-talk, beginning with social speech then private speech, increases in the early years, peaking when the child is about 5 years old and gradually decreasing as the child internalizes their speech to form inner speech or verbal thought. This proposition has been mostly supported, with research finding that overt self-talk peaks in the preschool years and gradually progresses to whispers and inaudible muttering (Winsler, 2009). However, full internalization has not been found in middle childhood as Vygotsky predicted, but much later than that (Behrend, Rosengren, & Perlmutter, 1989; Berk & Garvin, 1984; Krafft & Berk, 1998). For example, Winsler and Naglieri (2003) studied the self-talk of a nationally representative sample of over 2000 American children aged 5-17 years during the planned connections subtest of the Cognitive Assessment System (CAS), which taps planning and switching ability. They found that, as Vygotsky predicted, overt self-talk was used during the preschool years and decreased as the children aged. Whispers and inaudible muttering peaked in middle childhood and adolescents reported that they used inner speech. Thus, self-talk was evident across the different age-groups,
however, the nature of the self-talk use differed: overt private speech, whispers/inaudible muttering and inner speech differed across the age-groups reinforcing the notion that self-talk is used for cognitive and executive tasks in children of all ages. In addition to this, self-talk has also been documented in adults (Duncan & Cheyne, 1999, 2002).

While most research in this area has looked only at private speech, studies by Kohlberg, Yaeger and Hjertholm (1968) of early self-talk, showed that young children aged 4-5 years old use social speech extensively. This has led some researchers to look at self-talk by coding both private and social speech. Furrow (1984) and Sturn and Johnston (1999) found that self-talk, both private and social, had the same self-regulatory function especially in early childhood. This provides further support for Vygotsky’s theory of self-talk’s social origins, and of self-talk progressing from social to private to inner speech. In this thesis, all task relevant speech: private or social speech and inaudible muttering are collectively referred to as self-talk.

Berk (1986) developed a three stage hierarchy of self-talk internalization: Stage 1: task-irrelevant self-stimulating speech; Stage 2: task-relevant externalized speech; and Stage 3: less audible task-relevant speech. This hierarchy was supported by Berk’s (1986) study that showed that Grade 3 children displayed less stage 1 and 2 speech compared to preschool children during a mathematics task. Further studies, both cross-sectional (Berk & Potts, 1991; Berk & Spuhl, 1995; Winsler et al., 2003) and longitudinal (Winsler, Diaz, Atencio, McCarthy, & Adams Chabay, 2000), have confirmed Berk’s coding scheme with self-talk becoming more covert as children age. As Diaz et. al (1992) succinctly summarized, self-talk maturity is determined by the move from overt social and private speech to covert inner speech. Thus, one would anticipate that young children’s self-talk would have a combination of both social and private speech.
1.2.2 Microgenetic Changes

In addition to studies examining age-related changes in self-talk, microgenetic studies have looked at both changes in self-talk during the performance of a task and the relationship between task performance and self-talk. Typically these studies have involved children engaging in the same task multiple times within a relatively short time frame, for example, over a couple of weeks (Berk & Spuhl, 1995; Duncan & Cheyne, 2002), or being presented with multiple trials of a task administered in one session (A. Winsler, R. Diaz, & I. Montero, 1997a). Duncan and Pratt (1997) used both these methodologies and showed, in agreement with Vygotsky’s prediction, that as the task gets more difficult, self-talk increases, and that as children gain mastery over a task and the task is repeated and becomes familiar, their overt self-talk lessens. In terms of the relationship between self-talk and task performance, Diaz and Berk (1995) demonstrated that the amount of self-talk increased linearly as the task became more challenging and then reduced at the Zone of Proximal Development (ZPD). Behrend et al. (1989) defined the ZPD as the level of task difficulty at which a child cannot perform the task independently but might be able to perform it while working with an adult or more competent other. The same microgenetic pattern of reduced overtness and increased internalization of self-talk across repetitions of a task has been found in older children (Winsler & Naglieri, 2003), adolescents (Kronk, 1994) and adults (Duncan & Cheyne, 2001).

1.3 Functional Significance of Self-talk

Self-regulation, planning and problem solving develops through language. As we have seen, self-talk develops in early childhood and is used for self-regulation, planning and problem solving, which are often described as executive functions. Executive function is defined as goal-directed behavior, including planning and problem
solving, organized search, inhibition, switching and impulse control (Henry, Messer, & Nash, 2012). More recent research on the link between verbal mediation and cognition has shown that language is important during cognitively demanding tasks. There is evidence of positive associations between self-talk and performance on a variety of cognitive tasks such as theory of mind (Fernyhough & Meins, 2009), spatial problem solving (Sturn & Johnston, 1999), schoolwork (Bivens & Berk, 1990), visuo-spatial processing (Marton, 2008), and executive functioning tasks (Behrend, et al., 1989; Behrend, Rosengren, & Perlmutter, 1992; Fernyhough & Meins, 2009; Müller, Zelazo, Hood, Leone, & Rohrer, 2004; Winsler, Abar, Feder, Schunn, & Rubio, 2007; Winsler, Diaz, et al., 2000; Winsler, Manfra, & Diaz, 2007; Zelazo & Cunningham, 2007).

The role of self-talk in executive functioning has also been highlighted by Zelazo and his colleagues through their revised Cognitive Complexity and Control theory (CCC-r) and their Levels of Consciousness model (Zelazo et al., 2003). They contend that self-talk provides a space between the immediate environment and the self thus making it possible for children to be more aware of their activities and to gain control over their thoughts and behaviour. The CCC-r theory was revised after a series of nine experiments on young children using the Dimensional Change Card Sort test. In these experiments, Zelazo and his colleagues found that children use their self-talk to formulate and remember rules about the tasks in order to plan and problem solve, and that those who were able to use self-talk more effectively were more successful on the task. Several studies have noted that specifically asking children to use self-talk during executive tasks is typically associated with significant improvements in their performance, even for children as young as 3 years old (Berk & Spuhl, 1995; Kray, Eber, & Karbach, 2008; Müller, et al., 2004; Winsler, et al., 1997a; Winsler & Naglieri, 2003; Winsler, Naglieri, & Manfra, 2006).
1.3.1 The Link between Self-talk and Cognition

The relationship between language use and executive functions in both children and adults has also been investigated by researchers using experimental methods. These experimental studies have typically used dual task paradigms with articulatory suppression used to block the use of self-talk (Miyake, Emerson, Padilla, & Ahn, 2004). A typical experimental set up would have three conditions: executive task with no secondary task, executive task with an articulatory suppression task such as repeating a simple task-irrelevant word (e.g., Monday, Monday, Monday), and the executive task with a non-verbal task such as foot or finger tapping. Impaired performance during articulatory suppression relative to foot tapping is taken as evidence that self-talk is used during executive function tasks because articulatory suppression inhibits our ability to use self-talk. A recent study by Lidstone and colleagues (2010) used this method to examine the importance of self-talk for success on a planning and problem solving task, the Tower of London. The authors found that performance on the Tower of London was significantly impaired during articulatory suppression but not during foot tapping. Other studies have also examined the impact of articulatory suppression on the performance of a range of executive function tasks: the Tower of London (Wallace, Silvers, Martin, & Kenworthy, 2009), the Wisconsin Card Sorting Test (Baldo et al., 2005) and Raven Progressive Matrices (Kim, 2002). These studies found that performance on these various executive function tasks was impaired with articulatory suppression compared to foot tapping, reiterating the importance of self-talk for executive functioning.

1.3.2 The link between Self-talk and Self-regulation

The utility of self-talk for self-regulation has been recognized and used for therapeutic purposes. Self-talk has been used in a variety of clinical settings for both
children and adults, particularly during cognitive behaviour therapy, to assess, understand and modify thoughts through thought monitoring, self-instructions and self-affirmations. This has been found to lead to positive behavioural change (Nutt-Williams & Hill, 1996). Self-talk is an integral component to regulate thoughts, behaviours and emotions for various treatments including, but not limited to, anxiety (Kendall, 1994; Treadwell & Kendall, 1996), depression (Brown, Evans, Miller, Burgess, & Mueller, 1997; Robinson-Smith, Johnston, & Allen, 2000), social phobias (Butler, Cullington, Munby, Amies, & Gelder, 1984; Spence, Donovan, & Brechman-Toussaint, 2000) and internalizing problems (Calvete et al., 2005). Besides clinical settings, self-talk is also widely used in sports psychology as a method for directing motivation (regulating arousal, relaxation, maintaining stamina) and for self-instruction (telling the self what to do and increasing focus) to enhance the performance of athletes (Hardy, 2006; Theodorakis, Weinberg, Natsis, Douma, & Kazakas, 2000), supporting the link between self-talk and self-regulation.

However, in children, the majority of research linking self-talk and self-regulation has been carried out with children with behaviour problems, impulsivity and hyperactivity (Berk & Potts, 1991; Berk & Spuhl, 1995; Bivens & Berk, 1990; Diaz & Berk, 1995, 2014; Diaz, et al., 1992; Frauenglass & Diaz, 1985; Krafft & Berk, 1998; Winsler, Diaz, et al., 2000; Winsler, Manfra, et al., 2007). This research is reviewed in Section 1.4.1.

1.4 Self-talk in Special Populations

Given the link between self-talk, self-regulation and executive functioning, self-talk has been widely studied in some special populations of children that are known to have difficulties with self-regulation and/or executive functioning, such as children with Attention Deficit Hyperactivity Disorder (ADHD) and more recently, children with
Autism. There is also a growing interest in the self-talk of children with SLI because of their delayed or disordered language development, which might be expected to impact on their self-talk development.

1.4.1 Self-talk in Children with ADHD

The evidence supporting a positive association between self-talk and self-regulation, and self-talk and executive functioning, combined with the knowledge that children with ADHD have difficulty with impulse control and self-regulation (Barkley, 1997), led many early researchers in this area to assume that children with ADHD lack self-talk. They hypothesized that self-talk training would help children with ADHD reduce their impulsive behaviours and perform better on various cognitive and executive tasks (Kendall & Finch, 1978; Meichenbaum & Goodman, 1971). The most prominent programme in the 1970-1980s based on this premise was Meichenbaum and Goodman’s Self-Instructional Training (1971) which formed the basis of many self-instructional training programmes during this period. Although the initial results seemed promising, a critical meta-review of 13 efficacy reviews on self-instructional training found these programmes to be unsuccessful, largely due to several inaccurate underlying assumptions concerning the self-talk of children with ADHD and also the method of self-instructional training provided (Diaz & Berk, 1995).

The first assumption was that children with ADHD have poorer self-regulation because they have less self-talk compared to typically developing children. This was found to be inaccurate in studies by a number of researchers on the self-talk of children clinically diagnosed with ADHD (Benedetto-Nasho, 2001; Berk & Potts, 1991; Corkum, Humphries, Mullane, & Theriault, 2008; Kopecky, Chang, Klorman, Thatcher, & Borgstedt, 2005; Winsler, Abar, et al., 2007). These studies showed that instead of children with ADHD lacking self-talk, on the contrary, they had the same or more self-
talk compared to typically developing children during planning and problem solving. These studies were also consistent in noting that the self-talk of children with ADHD was less internalized compared to typically developing children. This has been interpreted as the verbal mediation of children with ADHD being less mature than typically developing children who, particularly in middle childhood, tend to use more inner speech and silent verbal thought.

Interestingly, in Corkum et al. (2008) and Winsler et al. (2007) studies, the cognitive task performance of typically developing children and those with ADHD was not different, but the amount of overt private speech was higher in children with ADHD. This was taken to indicate that children with ADHD need to use more self-talk to regulate their behaviour in order to perform the task on par with typically developing children. However, for executive functioning tasks, particularly inhibitory control tasks, children with ADHD typically have significantly lower performance compared to typically developing children, despite higher amounts of self-talk (Corkum, et al., 2008; Kopecky, et al., 2005). This differential impact has been interpreted as being due to the fact that as executive functioning tasks are challenging for children with ADHD, they need to use more self-talk to problem solve during moments of difficulty but that this is still insufficient to cope with the difficult items (Kopecky, et al., 2005). Another interpretation is that children with ADHD need to use self-talk to regulate their own behaviour as well as to perform the executive tasks, and thus, they need to use self-talk for both self-regulation and executive functioning (Winsler, 2009; Winsler, et al., 1999). Self-talk research on younger children with externalizing behaviour problems at risk of a diagnosis of ADHD has shown that these children have higher amounts of self-talk than children without externalizing behaviour problems, which is consistent with the research on children with ADHD (Winsler, et al., 1999; Winsler, Manfra, et al., 2007).
1.4.2 Self-talk in Children with Autism

More recently, the self-talk of children with autism has received substantial attention. Autism is characterized by persistent deficits in social communication and interactions, and restricted, repetitive patterns of behaviour, interests or activities, which must be present early in the child’s development and cause clinically significant impairments in functioning (Diagnostic and Statistical Manual for Psychiatric Disorders 5th Edition (DSM V), 2013). Considering the difficulty that children with autism experience in terms of social interactions, one would expect, given the support for Vygotsky’s theory that self-talk develops from social interaction in early childhood, that these children would have either a delay or a deviance in their self-talk development.

This has led several researchers to explore the self-talk of children with autism. The evidence concerning whether there is a delay or deviance in the self-talk of children with autism is mixed at best. Winsler et al. (2007) examined the self-talk of children diagnosed with high functioning autism during a planning and problem solving task. The authors noted that the self-talk of children with autism did not differ from typically developing children in terms of its quantity, function and timing of their self-talk, indicating neither a delay nor a deficit in self-talk in this population. This was supported by Williams, Happe and Jarrold (2008) who looked at inner speech during a short-term memory task in children with autism and a sample of children with generalized intellectual disabilities matched on chronological age and IQ. The researchers found evidence of intact self-talk in children with autism during short-term memory using an immediate serial recall task. However, several studies using dual task paradigms, which employ articulatory suppression as a means to inhibit self-talk, have shown that in contrast to typically developing children, children with autism are not affected by
articulatory suppression, which points towards an impairment in their self-talk (Holland & Low, 2010; Wallace, et al., 2009; Whitehouse, Maybery, & Durkin, 2006).

In light of these equivocal findings, several researchers have re-analysed the data from the afore-mentioned self-talk research. In a re-analysis of Whitehouse et al. (2006), Lidstone, Fernyhough, Meins and Whitehouse (2009) re-categorized the children with autism into two categories based on differences in their verbal and nonverbal IQ scores: those who had higher nonverbal skills than their verbal skills (NV>V) and those without this discrepancy (NV≤V). They found that only children with autism with the NV>V cognitive profile were unaffected by articulatory suppression, while children with autism in the NV≤V group were affected to a similar degree as typically developing children by articulatory suppression. The authors concluded that children with the NV>V cognitive profile were likely to have used strategies other than self-talk, such as visuo-spatial processing, to solve the problems whereas those with autism without discrepancies in their verbal and non-verbal IQ would tend to use self-talk and as a consequence, experience interference during articulatory suppression similar to typically developing children. In another re-analysis, Williams and Jarrold (2010) re-analysed their previous study (Williams, et al., 2008) to examine whether relative differences in cognitive profile or absolute verbal ability (as measured by verbal mental age) affected the self-talk of children with autism in relation to short-term memory. Their re-analysis indicated that self-talk was unaffected by differences in cognitive profiles. However, the verbal skills of the children with autism was a determining factor: children with a verbal mental age above 7 years showed evidence of intact self-talk use whereas those with a mental age below 7 years did not, indicating that children with autism with the verbal ability of the average 7 year old do utilise self-talk during short-term memory tasks. Therefore, this suggests multiple factors determine the use of self-talk by children with autism. Williams et al. (2010)
concluded that in children with autism, cognitive profile (i.e., relative verbal to non-verbal ability) may act as a determinant of self-talk use during executive functioning tasks such as planning and problem solving but absolute verbal mental age determines the use of self-talk during short-term memory tasks.

In a related study, Williams, Bowler, & Jarrold (2012) measured both executive functioning and short-term memory performance in adults with high functioning autism. Both groups were equally affected by articulatory suppression during the short-term memory tasks indicating no impairment in self-talk in individuals with autism during short-term memory tasks. However, unlike typical controls, participants with autism showed no decline in performance on the Tower of London task (measured in terms of accuracy) during articulatory suppression suggesting impairments in self-talk in individuals with autism during planning and problem solving. Post-hoc analysis suggested that individuals with autism relied on visuo-spatial skills rather than using self-talk to mediate planning on the Tower of London task. Furthermore, the authors found an association between the severity of communication difficulties and diminished self-talk use during planning, again providing a link between social interaction and self-talk development. The authors concluded that self-talk use in individuals with autism is task specific, and that they do not have an overall impairment in self-talk use. The authors further argued that the reason for this discrepancy is the nature of the self-talk itself. The self-talk used during planning and problem solving is dialogic in nature, in other words it is conversation to the self. Those individuals, such as people with autism, who have difficulty conversing with others (as indicated by their communication profile) are also likely to be poor at conversing with themselves, and therefore fail to employ self-talk during planning and problem solving. However, for short-term memory tasks, the self-talk employed does not involve communication with the self, instead it uses verbal labelling and cognitive rehearsals for verbatim recall (Winsler, et
Thus, this is not affected by the ability to communicate but, rather, it is dependent on verbal skills. The authors concluded that there is a difference in the type of self-talk employed, and that children with autism are not impaired in using self-talk for short-term memory but are impaired in using self-talk for planning and problem solving (Williams, et al., 2012).

Part of the challenge of interpreting the self-talk research conducted with individuals with autism is that it is a spectrum disorder with a large variation in terms of functioning and cognitive profile, making comparisons between studies particularly difficult. Although current research is suggestive of a specific impairment in self-talk impacting executive functioning in particular, more developmental and ontogenetic research on the self-talk of children with autism needs to be carried out to fill in the gaps and hopefully answer the question of why these variable findings exist.

Nonetheless, current evidence suggests that self-talk plays a role in planning and problem solving, in that children with more communication difficulties such as children with autism exhibit impairments in self-talk during planning and problem solving.

1.4.3 Self-talk in Children with Specific Language Impairment (SLI)

Following the theory that self-talk develops from social interaction with significant others in early childhood, the question arises as to whether children with language impairments would experience self-talk deficits. SLI is characterized by delayed or disordered language acquisition and development in children with at least average non-verbal intelligence, normal hearing, and no neurological impairment (Bishop & Baird, 2001). SLI affects approximately 7 in 100 children (Tomblin et al., 1997). Children with SLI may exhibit problems with morphology, phonology, syntax and semantics in varying degrees (Vallotton & Ayoub, 2011). These children typically have deficits in expressive language (Bishop, 1992) making it difficult for them to use
self-talk. In addition, children with SLI often have a receptive language impairment (Bishop, 1992) that limits their comprehension of, interaction with, and verbal scaffolding by, people around them. Therefore, children with SLI may have a double barrier to self-talk development.

There is surprisingly limited research with regard to self-talk in children with SLI. To the best of our knowledge, only two studies have looked directly at self-talk in this population. In the first exploratory study, Sturm and Johnston (1999) examined the self-talk of pre-schoolers with SLI compared to their typically developing peers during a problem solving construction task. Pairs of children attempted to complete a novel construction task of building a bridge across an imaginary river using craft materials supplied. The authors found that children with SLI displayed less self-talk overall than typically developing children. This could be taken to indicate that children with SLI have language for planning but use it less, or that children with SLI have less efficient self-talk. Sturm and Johnston (1999) also found that while typically developing children who had higher amounts of self-talk performed better on the task, the opposite was true for children with SLI, with higher verbosity leading to lower performance. Given that a high proportion of children with SLI display hyperactive and inattentive behaviours (Cohen et al, 2000), one possible explanation for this is that those children who were more verbose had more impulsive behaviours compared to children who were less verbose. Thus, these children may have been using more self-talk because they needed to self-regulate their behaviour as well as planning and problem solving, placing a double demand on an already limited cognitive resource. However, as the authors pointed out, their sample was small (N=6 in each group) which limited their ability to draw meaningful conclusions.

In the second study of self-talk in children with SLI, Lidstone and colleagues (2012) examined the self-talk of children with SLI and their typically developing peers
(aged 7-12 years) during planning and problem solving under dual task conditions. The authors compared Tower of London (TOL) performance without a dual task, TOL with articulatory suppression (repeating the word Monday, Monday, Monday), and TOL with a nonverbal task (foot tapping). The results indicated that performance on the TOL with articulatory suppression was significantly lower compared to performance during foot tapping suggesting that inhibition of self-talk was detrimental to planning and problem solving in both typically developing and children with SLI. This also suggests that both typically developing and children with SLI use self-talk to plan and problem solve. The authors also found that children with SLI performed significantly worse on the TOL compared to their typically developing peers on a baseline condition with no secondary task, but that they had sufficient self-talk to complete at least some of the TOL items. As these children were in middle childhood, the authors predicted that a delay in self-talk would manifest itself as self-talk being more overt than covert. The results confirmed their prediction that children with SLI were delayed in their self-talk compared to their typically developing peers in that they were more overt in their use of self-talk than typically developing children, who used more inner speech and verbal thought. Thus, both studies point towards a delay in self-talk in children with SLI, rather than a deviance in self-talk development in children with SLI.

Given the limited research regarding self-talk in children with SLI, more is clearly warranted. There is a particular need to look at self-talk in young children with SLI, as this is the critical stage of self-talk development. It is also important to determine whether any delay in self-talk also results in delays in the executive functioning of children with SLI. If future research shows that children with SLI have delayed self-talk, this may help to explain the documented deficits in performance on various cognitive and executive functioning tasks such as mathematics (Donlan, Cowan, Newton, & Lloyd, 2007), working memory (Martinussen & Tannock, 2006; Marton &
Schwartz, 2003; Noterdaeme, Amorosa, Mildenberger, Sitter, & Minow, 2001), visuospatial tasks (Marton, 2008), theory of mind (Fernyhough & Meins, 2009), and executive functioning tasks including inhibition (Bishop & Norbury, 2005; Henry, et al., 2012), simultaneous goal maintenance (Marton, 2008), sustained attention (Finneran, Francis, & Leonard, 2009), and planning and problem solving (Lidstone, Meins, & Fernyhough, 2012; Marton, 2008; Sturn & Johnston, 1999). Besides experiencing difficulties on executive functioning and cognitive tasks, children with SLI are also documented as having difficulties with emotional regulation and psychosocial skills (Botting & Conti-Ramsden, 2000; Cohen, 2005; Tomblin, et al., 1997; Yaratan & Yucesoylu, 2010), which could be due to their poorer self-talk as they may have difficulties with planning and problem solving during social interactions.

1.5 Self-talk Interventions

As mentioned previously, the connection between self-talk and executive functioning strengthened in the late 1960s, there was considerable interest in improving the behaviour control and self-regulation of children, particularly those with ADHD, through increasing their self-talk. In response to this, self-instructional training was developed and was fairly popular during the 1970-1980s as part of cognitive-behavioural intervention programmes which replaced strictly behavioural interventions such as modelling and shaping for children with behaviour problems (Diaz, et al., 1992). The self-instructional programmes were largely derived from Meichenbaum’s Self-Instructional Training (Meichenbaum & Goodman, 1971).

1.5.1 Meichenbaum and Goodman’s Self-Instructional Training

Meichenbaum and Goodman (1971) designed a cognitive-behavioural model of self-instructional training. The goal of this training was to develop cognitive processes,
such as cognitive rehearsal, through which children could meet the demands of a task, and to guide behaviour using self-instruction and self-reinforcement. There are 5 components to Self-Instructional Training as designed by Meichenbaum and Goodman: pay attention, inhibit / stop automatic responses to environmental stimuli, regulate behaviour and choose appropriate behaviour to be put in place, use rules and principles to guide behaviour and maintain a flow of action in working memory (Meichenbaum, 1985; Meichenbaum & Goodman, 1971). According to the authors, this training programme “follows the developmental sequence of cognitive self-guidance by which overt verbalisations of an adult experimenter, followed by the child’s overt self-verbalisations, followed by covert self-verbalisations would result in the child’s own control of his nonverbal behaviour” (Meichenbaum & Goodman, 1971, p. 116).

Therefore, the programme design, although based on Vygotsky’s principles, employed a purely cognitive-behavioural method of fading overt verbalizations with the aim of making the child ‘internalize’ the self-instructions provided. The self-instructional training followed these sequences: First, the experimenter performed a task talking aloud, providing an elaborate train of instructions which contained self-directed questions, answers to the questions in the form of planning and rehearsals, self-instructions while performing the task and self-reinforcement. Second, the child followed the experimenter’s instructions overtly while performing the task. Third, instructions were faded out and the child performed the task covertly with only lip movements but no sound when providing instructions to him/herself. Lastly, the child was asked to perform the task with fully covert self-instructions, with no lip movements. The authors concluded that the results from the self-instructional training had shown improvement in the task they targeted (i.e., copying a pattern) and were promising and effective in training impulsive children to talk to themselves and, as a result, to have better self-control. The authors were optimistic that self-instructional
training could be modified for the treatment of specific phobia, schizophrenia, smoking addiction and specific anxiety (Meichenbaum & Goodman, 1971). This model of self-instructional training was the basis of virtually all the self-instructional training programmes that flourished during the 1970s through to the 1980s (Harris, 1986; Kendall & Finch, 1978). However, a number of reviews of the efficacy of self-instructional training, conducted between 1984 and 1991, indicated extremely limited or no efficacy of self-instructional training on reducing impulsive behaviours in children with ADHD (Abikoff, 1991; Dush, Hirt, & Schroeder, 1989; Meador & Ollendick, 1984).

1.5.2 Critique of Cognitive-Behavioural Self-Instructional Training from the Vygotskian Perspective

In a critical meta-review of thirteen existing reviews of the efficacy of self-instructional training, Diaz and Berk (1995) concluded that self-instructional training had failed to promote self-regulatory skills and behaviour control on a long term basis. In their review, they argued that this failure was due to inaccurate central assumptions of the treatment itself in that although they based their theoretical background on Vygotsky’s views of the importance of self-talk, the manner in which the programme was implemented was at odds with his emphasis on the need for sensitive scaffolding of children’s language development.

Diaz and Berk (1995) discussed the main assumptions that were in contrast to Vygotskian principles of behaviour self-regulation and self-talk in children. The first assumption of self-instructional training was that children with impulsive behaviours and attentional deficits lacked or had deficits in self-talk. Although this seemed a logical assumption, this has been shown to be untrue. In fact, children with impulsive, externalizing behaviours or ADHD have more overt self-talk than their typically...
developing peers during planning and problem solving. However, they are more immature in their self-talk than typically developing children in that they use less covert self-talk (Berk & Landau, 1993; Berk & Potts, 1991). Diaz and Berk (1995) stated that it is important that an intervention programme follows a diagnosis of a problem, not precedes it. Thus, the authors concluded that self-instructional training failed because it was essentially training an already existing ability in these children with impulsive behaviour.

The second assumption of self-instructional training that contradicts Vygotskian principles is that modelling and rehearsing an adult’s script will increase spontaneous production of children’s self-talk. Diaz and Berk (1995) contend that children’s self-talk is not as elaborate, fluent and timely as the verbalizations demonstrated in self-instructional training. Self-talk in children is not a continuous broadcast of the current process, rather, children’s self-talk is often disjointed, sometimes seeming meaningless to the listener and can be rather brief. Thus, providing adults’ scripts is counter-productive to self-talk development in children as it increases cognitive load, particularly in children who have attention deficits or working memory impairments.

The third issue that is at odds with Vygotskian principles is that in Meichenbaum’s type of self-instructional training, it is assumed that speech and actions are automatically connected, that is, all speech influences behaviour. In self-instructional training, children are trained to repeat adult verbalizations during the task and it is assumed that the verbalizations provided will guide current actions. However, Vygotskian theory states that self-talk and actions are dynamic and influence each other. Also, the link between self-talk and action is not a given, but a product of development over time. In addition, children with impulsive behaviour may use self-talk to self-regulate other behaviours such as their attention and arousal, and to avoid distractions over and above the current task at hand (Berk & Potts, 1991).
Lastly, the concept of internalization of self-talk is not literally sub-vocalization as assumed in self-instructional training, where emphasis is given to the immediate practice of silent lip movements and covert instructions. Rather, internalization of self-talk from the Vygotskian point of view refers to a process of development of self-talk from an overt form of self-regulation that is both social and parasocial to intrapersonal self-regulation, the transformation of social communication to psychological communication with the self and an increase in the functional competence and automaticity within a specific domain such as planning and problem solving (Vygotsky, 1978, 1987). Diaz and Berk (1995) argued that self-instructional training had oversimplified the concept of internalization of self-talk to merely sub-vocalization and failed to see the functional significance of internalization of self-talk. In their concluding remarks, the authors state that self-talk training has the potential to have benefits if it is structured on the basis of accurate interpretation of Vygotskian theory in relation to verbal self-regulation, and current findings on the nature of self-talk in children, especially in special populations.

1.5.3 Vygotskian Inspired Self-talk Intervention

In the summary of their review, Diaz and Berk (1995) suggest that self-talk training strongly grounded on Vygotskian theory has good potential for success in enhancing self-talk in children. The authors proposed three principles for a successful self-talk training programme. The first principle that self-talk training needs to adhere to is that children are active learners and dynamically influence the interpersonal learning process. Learning should be a two-way interaction with good interpersonal communication at a level a child can comprehend rather than a one-way passing down of instructions from adult to child. Second, Vygotsky stated that play is an effective way to develop language in children. It is the most natural avenue for children to develop
self-regulation and thus, self-talk training should be done within a play-based setting to enhance motivation and encourage more learning. Third, self-regulation, planning and problem solving develop through language, thus children’s language development must be taken into account during self-talk training. The language used during self-talk training must be at the current language level of the children involved, thus, determining children’s current language level prior to self-talk training is important, particularly in children who may have language impairments. Vygotsky and Luria (1987) argued that tasks within the zone of proximal development are optimal for learning and that sensitive adult scaffolding during social interactions assist children to improve their self-talk and planning and problem solving ability. The zone of proximal development is a concept defined by Vygotsky as “the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance, or in collaboration with more capable peers” (Vygotsky, 1978, p. 86). Adults should be aware of this zone and choose tasks that are sufficiently challenging for children (Diaz & Berk, 1995; Moll, 1992; Vygotsky, 1987).

In response to self-instructional training, Diaz and colleagues (1992) designed a training programme that was based on the Vygotskian principles of sensitive scaffolding. That is, instead of giving specific adult verbalizations, they prompted children with leading questions, used verbal guidance when the children were faced with challenges, and let the children be independent when they were able to perform the task and use their own self-talk. Diaz et al. (1992) used sensitive scaffolding in their self-talk training programme with preschool children at risk of hyperactivity and impulsivity. The results showed that these children improved their performance on goal-directed tasks such as copying models with shapes, were more mature in their use of self-talk, and teachers noted reductions in their hyperactive and impulsive behaviours in
the classroom. Several other studies have also shown that adult scaffolding and teaching in joint activities is positively associated with children’s subsequent private speech development and better behaviour and planning performance (Berk & Spuhl, 1995; Winsler, et al., 1997a).

More recently, the Tools of the Mind curriculum for American preschool children was developed based on Vygotskian principles, with an emphasis on self-talk training and development. The aim of the Tools of the Mind prekindergarten curriculum is to enhance children's executive function skills within an instructional context that promotes the basic academic and social skills that prepare them for kindergarten and beyond. This is a play-based programme with a focus on literacy and mathematics and has been used widely in preschools in the United States. The Tools of the Mind programme is a curriculum used by pre-school teachers in their classrooms that encourages children to use their own self-talk to plan and during free play (Barnett et al., 2008; Bodrova & Leong, 2007). Randomized control trials comparing the Tools of the Mind programme with regular classroom instruction suggest that the programme is effective in enhancing children’s executive functioning and self-regulation of their behaviours (Diamond & Lee, 2011). However, other studies have shown no significant improvements in executive functioning or social behaviour in children in the Tools of the Mind programme compared to a ‘business as usual’ kindergarten (Wilson & Farran, 2012), and so, the evidence on the effectiveness of this programme is mixed.

1.6 Current Research

The focus of the present thesis is on self-talk in children with SLI, particularly their self-talk during planning and problem solving. Although these children have well known deficits and delays in both receptive and expressive language, there are only two studies on self-talk in children with SLI to date, one with a very limited sample and
another with a sample of children with SLI that was collapsed across age groups (7-12 years old). Thus, there is no research comparing the self-talk of children with SLI across age groups, as the two studies reviewed (Lidstone, et al., 2012; Sturn & Johnston, 1999) did not examine age or age group as a variable. Furthermore, there has been no research on children with SLI with hyperactive and inattentive behaviours. In addition, there have been no intervention studies aimed at increasing self-talk in children with SLI to date. Thus, there is a wide gap in self-talk research in this population. Therefore, the main aims of this research were to: 1) examine self-talk during planning and problem solving in young children with SLI aged 4-7 years old compared to their typically developing peers, 2) to design a Vygotskian play-based self-talk intervention programme to be used with children with SLI, and 3) to test the effectiveness of the self-talk training programme in enhancing self-talk and the planning and problem solving performance in children with SLI.

We were particularly interested in the utility of self-talk during planning and problem solving. To capture the full range of self-talk used during the planning and problem solving task and to examine the nature of the self-talk used across the different age groups, it was vital to code all types of self-talk: social and private speech and inaudible muttering. Including social speech was regarded as important given that these children are young and have a language impairment, and so, may tend to use more social rather than private speech.

The main aim of Chapter 2 was to examine the self-talk of children with SLI and to determine whether they had delays in their self-talk development. Chapter 2 consists of a cross-sectional study (Study 1) of the self-talk used during planning and problem solving by young children with SLI and their age and non-verbal IQ matched typically developing peers across the three earliest grade levels of school (Kindergarten, Preprimary and Year 1). We also examined a subset of children with SLI that has
received very little attention, namely children with hyperactive and inattentive behaviours. We used the mechanical version of the Tower of London task (TOL) as the planning and problem solving task, as this is a task well-known for eliciting self-talk and is suitable for young children. The TOL has been used in various self-talk studies including the study of children with SLI by Lidstone and colleagues (2012). Study 1, reported in Chapter 2, used a larger sample of children with SLI than the previous two studies on self-talk in children with SLI. Study 1 provides evidence that children with SLI use self-talk for planning and problem solving, but that there is a delay in the development of their self-talk relative to typically developing children, particularly in the amount and maturity of self-talk. Children with SLI were also significantly impaired in terms of performance on the planning and problem solving task compared to their typically developing peers. Based on these findings, we designed a self-talk training programme. This programme is presented in Chapter 3.

To the best of our knowledge, this is the first self-talk training programme designed specifically for children with SLI. Our programme used Meichenbaum and Goodman’s five components of self-instructional training. The five components are: pay attention, inhibit / stop automatic responses to environmental stimuli, regulate behaviour and choose appropriate behaviour to be put in place, use rules and principles to guide behaviour and maintain a flow of action in working memory. However, we did not follow Meichenbaum and Goodman’s method, instead, we followed Diaz and Berk’s (1995) recommendations and based our self-talk training on Vygotskian principles using language that is present in the repertoire of children with SLI. Our play-based self-talk training also used sensitive scaffolding, interpersonal communication, and tasks within the zone of proximal development. The intervention programme comprised of ten sessions, each lasting 30 minutes, and primarily used Lego building tasks and craft activities as the play materials. Parents and teachers were also involved
during this programme to enhance and reinforce the sessions’ content at home and in the classroom.

Chapter 4 reports a study (Study 2) of the effectiveness of the Vygotskian play-based self-instructional training programme presented in Chapter 3. We examined whether self-talk training was effective in enhancing self-talk in children with SLI and subsequently, if the self-talk training improved these children’s planning and problem solving as measured by performance on the TOL. This research involved a wait-list control, whereby half the children with SLI received training first while the other half did no training. After the second test session with an isoform (i.e., a parallel version of the TOL with the same difficulty levels but different ball configurations) of the TOL, the second group received self-talk training while the group who had already received self-talk training did not receive additional training. All children were then retested using another isoform of the TOL. Typically developing peers were tested at the same three time points to assess any developmental changes. Changes in children’s behaviour were also monitored using the Strengths and Difficulties Questionnaire.

The results from the entire research project are summarized in Chapter 5, and wider implications and the clinical significance of the findings are also discussed. In this final chapter we also review the methodological limitations of the studies as well as provide suggestions for future directions of research.
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Chapter 2

Self-talk during Planning and Problem Solving in Children with SLI and their Typically Developing Peers

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This paper is currently under review at Development and Psychopathology.
Abstract

Self-talk during Planning and Problem Solving in Children with SLI and their Typically Developing Peers

This cross sectional study examined self-talk during the planning and problem solving of 4- to 7-year-old children with Specific Language Impairment (SLI) \( n=91 \) and Typically Developing children (TD) \( n=81 \), with and without hyperactive and inattentive behaviours. Children across three grade levels completed the mechanical Tower of London (TOL). Children with SLI scored lower on the TOL than TD children, and children with hyperactive and inattentive behaviours performed worse than those without hyperactive and inattentive behaviours, but only in the SLI group. This suggests that children with SLI and hyperactive and inattentive behaviours experience a double deficit. Children with SLI had less self-talk overall and significantly less inaudible muttering compared to TD children. This points towards a significant delay in development and internalization of self-talk in the SLI group which should be taken into account when considering the planning and problem solving of young children with SLI.

Keywords: Children, Self-talk, Private Speech SLI, Planning, Hyperactive and Inattentive Behaviours
We all talk to ourselves, mostly through inner speech and verbal thought but sometimes, even as adults, we talk to ourselves out loud, usually when we need to attend to cognitively demanding tasks. Historically, major theorists have agreed that language is essential for cognitive development. For example, Piaget and Inhelder (1977) considered conceptual development and constructive thoughts to stem from language and communications with others. Vygotsky (1987) theorized that language, especially “speech for the self”, is essential for basic mental operations and executive functions including self-regulation, planning and problem solving. Expanding on Vygotsky’s early work, many researchers have examined the importance of self-talk for cognition and behaviour, with self-talk referred to in these various studies as private speech (Winsler & Diaz, 1995; Winsler, et al., 1999; Winsler, et al., 1997a), inner speech (Al-Namlah, Fernyhough, & Meins, 2006; Fernyhough & Meins, 2009; Lidstone, et al., 2010), self-directed speech (Lidstone, et al., 2012), self-instructional speech (Meichenbaum, 1985; Meichenbaum & Goodman, 1971) and self-talk (Hatzigeorgiadis, Zourbanos, & Theodorakis, 2007; Theodorakis, et al., 2000). For the purpose of this paper, we will use the term self-talk to refer to speech that is used for the benefit of one’s self. This includes private speech, social speech and inaudible muttering. While many researchers have looked at self-talk in typically developing children and children with ADHD, there is limited research on the self-talk of young children with Specific Language Impairment (SLI) compared to typically developing children. Given that children with SLI have a language impairment and are often delayed on many cognitive and executive measures (Bishop, 1992), an investigation of self-talk in this population is particularly relevant. This is the aim of our paper.

Research investigating the development of self-talk has shown that pre-school children often talk overtly through their activities to regulate their thoughts and behaviours (Diaz, et al., 1992; Winsler, Manfra, et al., 2007; Zelazo, et al., 2003). They
use their language, both speech directed to others and to themselves (social and private speech respectively), to plan and problem solve (Furrow, 1984; Sturn & Johnston, 1999; Winsler, 2009; Winsler & Naglieri, 2003). As children age, their overt speech becomes more internalized to form inaudible muttering and silent lip movements, and progresses to inner speech and complete verbal thought by middle childhood (Berk & Spuhl, 1995; Duncan & Pratt, 1997; Vygotsky, 1978; Winsler, 2009; Winsler & Naglieri, 2003). In addition to age-related changes, microgenetic studies have shown that the amount of self-talk tends to increase linearly as the task gets more challenging and to then reduce and be ineffective when the task gets too difficult. (Berk & Spuhl, 1995; Duncan & Pratt, 1997; Winsler, et al., 1997a). This exact same pattern of changes in self-talk associated with changes in task difficulty has been found in older children (Winsler & Naglieri, 2003), adolescents (Kronk, 1994) and adults (Duncan & Cheyne, 2002).

Research linking language and cognition has lent support to the notion that language is paramount during cognitively demanding tasks. Positive associations have been found between children’s use of self-talk and performance on a variety of cognitive tasks such as theory of mind (Fernyhough & Meins, 2009), visuo-spatial processing (Marton, 2008), schoolwork (Bivens & Berk, 1990), spatial problem solving (Sturn & Johnston, 1999), and executive functioning tasks (Behrend, et al., 1992; Fernyhough & Fradley, 2005; Marton, 2008). In addition to the findings above, there is also evidence to show that typically developing (TD) children with weaker language abilities (low average range) have poorer planning (Fernyhough & Fradley, 2005; Winsler, et al., 1997a) and general problem solving abilities (Behrend, et al., 1989; 1992) reiterating the association between language use and cognition.

While language use, especially self-talk, is thought to be important for all executive functions, studies examining the relationship between self-talk and executive functioning have tended to use planning and problem solving tasks such as the Tower of
London to elicit self-talk (Winsler, 2009). Planning and problem solving are required in order to formulate, select, and evaluate a sequence of thoughts and actions to achieve a desired goal (D’Zurilla & Goldfried, 1971; Stuss, 1992). These abilities are of particular importance in children because they are required to deal with many of the academic and social tasks that a child faces, such as organizing themselves and their work, writing essays, planning and executing projects, time management, managing social interactions, and developing friendships (Ellis & Siegler, 1997; Sandberg & Huttenlocher, 2001). Intervention studies support the notion that planning and problem solving tasks are verbally mediated and dependent upon self-talk during the course of typical development in children. For example, in a study by Diaz, Winsler, Atencio and Harbers (1992) pre-schoolers who were explicitly taught to use self-talk performed significantly better on planning and problem solving tasks and showed a reduction in impulsive behaviours compared to children who were not given the strategy. Other studies have linked adult scaffolding to greater self-talk in children which was associated with better performance in various collaborative problem solving tasks (Winsler, Diaz, et al., 2000; Winsler, et al., 1997a). In addition to this, verbal scaffolding by mothers of children as young as 3 years of age during free play has been shown to predict executive functioning at age 6 (Landry, et al., 2002).

Recent evidence for the use of language for planning and problem-solving has also been demonstrated in experimental studies. Research using articulatory suppression tasks, where self-talk is prevented by asking participants to repeat a word (e.g., Monday, Monday, Monday) over and over again while performing a task, has been shown to impair performance on several planning and problem solving tasks including the Tower of London (Lidstone, et al., 2010; Wallace, et al., 2009), the Wisconsin Card Sorting Test (Baldo, et al., 2005) and Raven Progressive Matrices (Kim, 2002). In contrast, the concurrent performance of other tasks that do not involve language does
not show this effect (Kim, 2002; Lidstone, et al., 2010; Wallace, et al., 2009), providing strong evidence that language is important for planning and problem solving (Lidstone, et al., 2010). In sum, when language is required but is prevented, cognitive performance during planning and self-regulation is negatively affected.

The importance of language for successful planning and problem solving raises an important question as to what happens in children who have either delayed or disordered language development, such as children diagnosed with Specific Language Impairment (SLI). SLI is a term used to describe delayed or disordered language acquisition and development in children with at least average non-verbal intelligence, normal hearing, and no neurological impairment (Bishop & Baird, 2001). SLI affects approximately 7 in 100 children (Tomblin, et al., 1997). Children with SLI may exhibit problems with morphology, phonology, syntax and semantics in varying degrees (Vallotton & Ayoub, 2011). These children typically have deficits in expressive language (Bishop, 1992) making it difficult for them to use self-talk. In addition, children with SLI often have a receptive language impairment (Bishop, 1992) that limits their comprehension of, interaction with, and verbal scaffolding by, people around them. Therefore, children with SLI may have a double barrier to self-talk development. For this reason, it is vital to examine the development of self-talk in children with SLI, and the impact of any delays or deficits on planning and problem solving performance.

The current limited research in the area of self-talk in children with SLI points towards a delay in the development of self-talk, with their self-talk following a typical but delayed pattern compared to typically developing children (Lidstone, et al., 2012; Sturm & Johnston, 1999). This delay in the development of self-talk may help explain in part the acknowledged deficits in a variety of cognitive tasks seen in children with SLI. These children have been shown to have poorer performance than TD children in mathematics (Donlan, et al., 2007), working memory (Martinussen & Tannock, 2006;
Marton & Schwartz, 2003; Noterdaeme, et al., 2001), visuo-spatial tasks (Marton, 2008), theory of mind (Fernyhough & Meins, 2009), and executive functioning tasks including inhibition (Bishop & Norbury, 2005; Henry, et al., 2012), simultaneous goal maintenance (Marton, 2008), sustained attention (Finneran, et al., 2009), and planning and problem solving (Lidstone, et al., 2012; Marton, 2008; Sturn & Johnston, 1999). Children with SLI are also documented to have difficulties in emotional regulation and psychosocial skills (Botting & Conti-Ramsden, 2000; Cohen, 2005; Tomblin, et al., 1997; Yaratan & Yucesoylu, 2010). These deficits have been interpreted either as the consequence of a general processing problem (Donlan, et al., 2007; Newton, Roberts, & Donlan, 2010) or to impairments in self-talk (Bishop & Norbury, 2005; Fujiki, Spackman, Brinton, & Hall, 2004; Mainela-Arnold, Evans, & Alibali, 2006). However, research specifically examining self-talk in children with SLI is scarce.

To the best of our knowledge, there are only two studies on self-talk in children with SLI. In the first study, Sturn and Johnston (1999) observed preschoolers with SLI and matched peers completing a construction task and recorded their overt speech, both private and social. They found that children with SLI talked less overall compared to typically developing children, producing less task relevant and task irrelevant speech. They also performed more poorly on the construction task compared to their TD peers. Sturn and Johnston (1999) concluded that children with SLI are less likely than TD children to use language for cognitive purposes, and found that among the children with SLI, those who were more verbose had poorer performance, the exact opposite of the pattern shown by TD children. However, as the authors indicated, the small numbers in each group (N=6) and considerable within group variance limited their ability to draw strong conclusions.

In the second study to address self-talk in children with SLI, Lidstone et al. (2012) assessed SLI and TD children aged 7-11 years to examine the role of self-talk during
planning and problem solving on the Tower of London (TOL) task. The children completed the TOL under normal conditions and under dual task conditions (articulatory suppression and foot tapping). Lidstone et al. (2012) found that children with SLI performed more poorly than controls on the TOL and had less internalized and more overt self-talk than their age and non-verbal intelligence matched typically developing peers. This points towards a delayed developmental pattern of self-talk in children with SLI. A second finding of this study was that, relative to foot tapping, articulatory suppression affected the TOL performance of both groups to a similar extent and as a result, the authors concluded that the impaired performance of the children with SLI could not be accounted for in terms of their delayed self-talk. However the analysis of the effect of articulatory suppression did not include a control condition in which no articulatory suppression or concurrent dual-task was performed, which makes interpretation of this effect difficult. Comparing the mean TOL performance of the SLI and TD control groups across the TOL only and articulatory suppression conditions suggests that the SLI group were relatively unaffected by the introduction of articulatory suppression (M = 41.8 and 42.9 respectively) whereas the control group did show a decrement (M = 56.5 and 50 respectively). This pattern is consistent with the idea that children with SLI were not using their self-talk to the same extent or as effectively as the control children.

Further complicating the study of language and executive functioning, particularly self-talk during planning and problem solving in children with SLI, is the documented comorbidity with hyperactivity and inattentiveness in a large number of these children. For example, several studies have indicated that there is a large proportion (25-45%) of children with SLI who also demonstrate hyperactive and inattentive behaviours (Bishop & Norbury, 2005; Cohen, 2005; Marton, 2008). This is important to note because there is converging evidence to suggest that hyperactive and inattentive behaviours may be
associated with poor planning and problem solving performance in children. A meta-analytic review of 83 studies on children with hyperactivity and inattention and their TD peers showed that children with hyperactivity and inattention consistently display deficits on a number of executive function tasks, including planning (Willcutt, Doyle, Nigg, Faraone, & Pennington, 2005). In addition, several studies focusing specifically on planning and self-regulation oriented tasks have documented poorer performance by hyperactive and inattentive children relative to TD children (Kopecky, et al., 2005; Winsler, Diaz, et al., 2000; Winsler, Manfra, et al., 2007). This deficit has been partly attributed to having less effective self-talk during planning and problem solving. Within the SLI population, there is evidence to show that having hyperactivity and inattention in addition to language difficulties further reduces performance on executive functioning, including planning and problem solving (Cohen et al., 2000; Im-Bolter & Cohen, 2007; Jonsdottir, Bouma, & Sergeant, 2005; Marton, 2008). Therefore, it is vital that we look not only at the self-talk of children with SLI in general, but also examine the population of children with SLI and hyperactive and inattentive behaviours more closely, as any difficulties they may have with planning and problem solving may be intensified relative to children with SLI without such behaviours.

Unlike the scarcity of self-talk research in children with SLI, self-talk has been researched in detail in children with hyperactivity and inattention. Numerous studies have come to an almost unanimous conclusion that while children with hyperactive and inattentive behaviours possess self-talk and are able to use self-talk during executive functioning tasks, their self-talk is delayed in terms of its internalization. That is, they are more overt (i.e., more immature) in their use of self-talk compared with TD children of the same age (Corkum, et al., 2008; Diaz, et al., 1992; Winsler, Diaz, et al., 2000). It appears that self-talk is essential for children with hyperactivity and inattention in that they use it to self-regulate their behaviour whilst performing a task, especially when
presented with a cognitively demanding task (Winsler, 2009). However, evidence suggests that children with hyperactive and inattentive behaviours do not use self-talk to plan as effectively as typically developing children (Berk & Potts, 1991; Corkum, et al., 2008; Kopecky, et al., 2005; Winsler, Diaz, et al., 2000).

Taken together, the two studies on self-talk in children with SLI provide an excellent starting point in understanding SLI and its effects on self-talk and planning. However, there are a few issues that warrant addressing. First, no studies have examined changes in self-talk across age within the SLI group; Sturn and Johnston (1999) studied 4-5 year olds and Lidstone et al. (2012) looked at 7-12 year old children with SLI as a single group. Second, given that there is evidence that children with SLI and hyperactive and inattentive behaviour display poorer executive functioning, it is pertinent to examine self-talk in children with hyperactive and inattentive behaviours within the SLI group. To the best of our knowledge no such studies exist.

**The present study**

The first aim of this study was to examine the self-talk of young children with SLI (aged 4-7 years) and their TD peers during planning and problem solving as measured by performance on the TOL. As these children are young and have a language impairment, we coded both private and social speech to ensure we captured their full self-talk as it has been documented that the self-talk of young children contains both private and social speech (Sturn & Johnston, 1999; Winsler, 2009). To address the issue of whether children with SLI have delays in self-talk, accompanied by delays in planning and problem solving, the self-talk and planning and problem solving performance of both groups was examined across three year groups (Kindergarten, Preprimary and Year 1). By comparing the performance of the two language groups across the different year groups, we were able to examine whether the self-talk and
planning and problem solving of children with SLI was delayed relative to TD children. Given that only three year groups were assessed, we were able to assess delays of up to two years (i.e., by comparing the performance of the children with SLI in Year 1 to that of TD children in Preprimary and Kindergarten).

The second aim of this study was to investigate one subset of children with SLI who have received very little attention to date, namely, children with SLI and hyperactive and inattentive behaviours. Given the high proportion of children with hyperactive and inattentive behaviours within the SLI population and evidence that TD children with hyperactivity and inattentiveness have different self-talk to TD children without hyperactive and inattentive behaviours, we considered it important to examine the self-talk of children with SLI with and without hyperactive and inattentive behaviours separately. Thus, to examine the impact of both SLI and hyperactive and inattentive behaviours on self-talk and planning, we compared the self-talk and TOL performance of children with SLI, with and without hyperactive and inattentive behaviours, to the performance of TD children, with and without hyperactive and inattentive behaviours.

The third aim of this study was to examine the self-talk produced on individual items of the TOL and subsequent performance on these items. This will provide a clearer understanding of the link between self-talk and performance on the TOL. To the best of our knowledge, no such study exists within the SLI population. Given this gap in the literature, we were interested to see if children were more likely to get an item correct when they were talking or silent and if there are differences between the language and behaviour groups.
Method

Participants

One hundred and seventy eight 4- to 7-year-old children (age range: 48 - 80 months) were recruited from Primary schools and Language Development Centres (LDCs) in Perth, Western Australia. All children were in Kindergarten (age: 4-5 years old), Pre-primary (age 5-6 years old) or Year 1 (6-7 years old) at the time of recruitment and data collection.

LDCs are specialist teaching schools for children in their first three years of schooling (Kindergarten to Year 1) who have been diagnosed with SLI. Children attending the LDCs have been assessed by speech pathologists and psychologists, using standardized tests and clinical judgment, as having significantly impaired language development in combination with adequate adaptive behaviours and at least average nonverbal intelligence prior to acceptance by the LDCs. LDCs are located throughout greater metropolitan Perth, as a subsection of a bigger primary school.

In this study, 94 children with SLI were recruited from LDCs in five different suburban areas. Eighty four TD children were recruited from the same school area as the children with SLI to increase the likelihood that the groups were equivalent in terms of socioeconomic background. Inclusion criteria required all children involved in the study to have average to high average nonverbal IQ, defined as scores of 85-125 on the Wechsler Non-Verbal Scale of Ability (WNV), and to be able to pass the practice items on the TOL. Children with SLI were also required to score below average on the general communication composite (GCC) of the Children’s Communication Checklist – Second Edition (CCC-2), while the TD children were required to have at least average scores on this test. Six children did not meet the inclusion criteria: three children with SLI (two had lower than average nonverbal IQ and one could not complete the TOL practice
trials), and three TD children because their nonverbal IQ scores were >125. In addition, for the self-talk analysis, one child with SLI was excluded from the study due to technical difficulties with the video recorder. Descriptive data are provided in Table 1.

Table 1

Means and Standard Deviations for Age, Non-Verbal IQ and General Language in TD and Children with SLI

<table>
<thead>
<tr>
<th>Group</th>
<th>n</th>
<th>Age in months (SD)</th>
<th>WNV scores (SD)</th>
<th>GCC scores (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SLI</td>
<td>91</td>
<td>63.27 (9.18)</td>
<td>103.34 (10.83)</td>
<td>47.72 (11.96)</td>
</tr>
<tr>
<td>Male</td>
<td>62</td>
<td>63.54 (9.66)</td>
<td>103.08 (11.59)</td>
<td>47.47 (12.06)</td>
</tr>
<tr>
<td>Female</td>
<td>29</td>
<td>61.93 (8.25)</td>
<td>103.28 (10.90)</td>
<td>48.30 (11.92)</td>
</tr>
<tr>
<td>K</td>
<td>35</td>
<td>53.35 (2.33)</td>
<td>104.32 (12.01)</td>
<td>51.68 (9.96)</td>
</tr>
<tr>
<td>PP</td>
<td>24</td>
<td>64.21 (3.31)</td>
<td>104.08 (11.07)</td>
<td>47.13 (12.05)</td>
</tr>
<tr>
<td>Y1</td>
<td>32</td>
<td>73.36 (3.99)</td>
<td>101.06 (10.73)</td>
<td>43.70 (12.86)</td>
</tr>
<tr>
<td>Hyp</td>
<td>31</td>
<td>63.53 (9.82)</td>
<td>101.44 (11.93)</td>
<td>46.33 (15.96)</td>
</tr>
<tr>
<td>NonHyp</td>
<td>60</td>
<td>62.79 (8.98)</td>
<td>104.03 (10.98)</td>
<td>48.35 (9.74)</td>
</tr>
<tr>
<td>TD</td>
<td>81</td>
<td>65.76 (10.33)</td>
<td>108.56 (9.27)</td>
<td>77.96 (14.25)</td>
</tr>
<tr>
<td>Male</td>
<td>48</td>
<td>65.00 (10.34)</td>
<td>108.33 (9.29)</td>
<td>78.04 (14.50)</td>
</tr>
<tr>
<td>Female</td>
<td>33</td>
<td>65.58 (10.87)</td>
<td>109.36 (9.62)</td>
<td>77.86 (14.12)</td>
</tr>
<tr>
<td>K</td>
<td>25</td>
<td>52.68 (3.91)</td>
<td>108.43 (9.54)</td>
<td>78.46 (12.29)</td>
</tr>
<tr>
<td>PP</td>
<td>24</td>
<td>65.67 (4.09)</td>
<td>110.62 (8.92)</td>
<td>80.96 (14.79)</td>
</tr>
<tr>
<td>Y1</td>
<td>32</td>
<td>75.94 (3.05)</td>
<td>107.69 (9.67)</td>
<td>75.25 (15.34)</td>
</tr>
<tr>
<td>Hyp</td>
<td>11</td>
<td>67.00 (10.69)</td>
<td>103.36 (10.41)</td>
<td>72.64 (13.40)</td>
</tr>
<tr>
<td>NonHyp</td>
<td>70</td>
<td>64.99 (10.53)</td>
<td>109.59 (9.08)</td>
<td>78.77 (14.29)</td>
</tr>
</tbody>
</table>

Note: SD: Standard deviation, K=Kindergarten, PP=Preprimary, Y1=Year 1, Hyp=Children with Hyperactive and Inattentive Behaviours, NonHyp: Children with No Hyperactive and Inattentive Behaviour, GCC: General Communications Composite of the CCC-2, WNV: Wechsler Nonverbal Scale of Intelligence
Tasks and Procedures

**Nonverbal ability.** A measure of nonverbal IQ was provided by two screening subtests from the Wechsler Non-Verbal Scale of Ability (WNV: Naglieri & Brunner, 2009; Wechsler & Naglieri, 2006), Matrices and Recognition. These subtests were used as they were not part of the psychometric testing previously carried out with children in the LDC. The reliability of the WNV for this age group is between .88 and .91.

**Language ability.** The Children’s Communication Checklist-second edition (CCC-2; Bishop, 2003) was completed by parents of participants and used to screen for pragmatic language impairment and SLI. This screening was carried out to ensure average communication ability in typically developing children and to confirm below average communication ability in children with SLI. The reliability of the CCC-2 ranges from .86 to .96 for this age group. The CCC-2 was scored using the computerized scoring software provided by the test publishers. The criteria for below average communication ability were a cut-off score of below 55 on the GCC or scores below the 10th percentile on three subscales (Bishop, 2003), which are indicative of SLI. None of the TD children in this study met the CCC-2 criteria for SLI, while all of the children with SLI did, confirming their previous diagnosis. Thus, the GCC scores were significantly different between the language groups, \( t (170) = -14.74, p < .001 \).

**Behaviour rating.** The Strengths and Difficulties Questionnaire (SDQ; Goodman, 2001) is a short, 25-item behavioural screening questionnaire with 5 subscales: emotional symptoms, conduct problems, hyperactivity/inattention, peer relationship problem and prosocial behaviours. The hyperactivity and inattentiveness subscale was the measure of interest in this study. Children scoring 7-10 in the hyperactive and inattentive subscale were categorized as having hyperactive and inattentive behaviours. This cut-off indicates a ‘high substantial risk of clinically significant problems in this area’ (Goodman & Scott, 1999). However, it is important to
note that, being a screening tool, this does not amount to a diagnosis of ADHD. The SDQ has moderate to strong reliability across all its subscales and sound external validity (Hawes & Dadds, 2004) with a correlation of .87 with the Child Behaviour Checklist (CBCL) (Goodman & Scott, 1999). The SDQ was scored and converted to standard scores based on Australian norms provided by Mellor (2004).

**Planning task.** Shallice’s (1982) TOL test was used as a measure of planning and problem solving abilities. This is a short and engaging spatial planning task presented in game-form, which can be administered to children from 4 years of age onwards (Bull, Espy & Senn, 2004). As previously indicated, the TOL has been extensively used in executive functioning and self-talk research in children (Berg & Byrd, 2002; Berg, Byrd, McNamara, & Case, 2010; Shriberg, Tomblin, & McSweeny, 1999; Winsler, Fernyhough, & Montero, 2009) and has been shown to require planning and problem solving for successful performance (Lidstone, et al., 2010, 2012; Phillips, Wynn, McPherson, & Gilhooly, 2001; Williams & Jarrold, 2010). Another important reason for using the TOL is that the instructions are short and easily demonstrable unlike many well-established executive functioning tests for very young children (Culbertson & Zillmer, 1998). This is especially helpful for our population of interest because children with SLI, who have receptive language impairments, find complex verbal instructions extremely difficult to comprehend. While the TOL is available in both mechanical and computerized versions, the mechanical form was used in this study for a number of reasons. First, the use of this version allows comparison with previous research examining self-talk and planning in children, which has typically used the mechanical TOL. Second, the mechanical form of the TOL is appealing to young children due to its novelty and game-like appeal and is usually described to children as a ‘ball puzzle game’. Third, young children may have had limited experience with a computer and computer games. Finally, a one to one session with an examiner also
helps to engage and sustain children’s attention throughout testing. The mechanical form of the TOL uses a pair of identical wooden game boards, one each for the child and the examiner. The game boards consisted of three pegs: short, medium and tall, which hold one, two or three balls of the same size, respectively. Each ball was a different colour: either yellow, blue or red. The children were asked to change the configuration of the balls on the pegs of their board to match the ball configuration on the examiner’s board in the minimum number of moves.

In this study the TOL consisted of 4 practice items and 17 structurally unique test problems increasing in complexity from problems that could be solved in a minimum of 3 moves up to a minimum of 7 moves per item. This series was adapted from a computerized TOL version developed by W. Keith Berg and colleagues (Berg & Byrd, 2002; Berg, et al., 2010). The TOL followed the procedures used in a previous study by MacDonald and Berg (2005). The child was told the three rules to the ball puzzle game: 1) only one ball could be moved at a time, 2) the balls could only be placed on a stick and not anywhere else, 3) the shortest stick could only hold one ball, the medium stick could hold two balls and the tallest stick could hold three balls. The child was asked to put his/her non-dominant hand in a glove and was instructed not to use the hand in the glove. This is a modification of the standard method of asking the child to place one hand behind their back to prevent them from moving two balls at one time. The glove served as a visual reminder for young children to only use one hand and to move only one ball at a time.

Each child was given the four practice items. If the child failed the first trial of a practice item, teaching was provided. All children were required to pass two or more practice items before beginning the test items, starting with the simplest. Each problem proceeded until either the child completed the problem, gave up, or violated a rule. If a child showed intention of violating a rule but had not moved the ball from the peg (e.g.,
holding two balls at one time), the child’s movement was stopped, the rules were repeated again, and they were allowed to continue with the task. However, if the child had already violated the rule, such as moving two balls at once and putting them on another peg, the child’s movement was stopped, the rules were repeated again and the balls were returned to the original start state. These violations were classified as rule breaks. A fail was recorded for the trial and the child was given a second trial on the same test item. If the child failed both trials of a given item, they were considered to have failed the item and were given the next item. Timing for each item began when the examiner presented the game boards to the child and ended when the child completed the item or when they gave up after trying. To reduce distress, testing was discontinued when a child failed three consecutive items or completed the last item.

**General Procedure**

Parents and school principals gave informed consent for children to participate prior to testing. To ensure all children met inclusion criteria, they were screened with the WNV. In addition, parents completed the Children’s Communications Checklist – 2nd edition (CCC-2) and the SDQ-Parent, and teachers completed the SDQ-Teacher.

The Tower of London (TOL) task was administered individually to each child by an examiner. Two examiners tested the children; both were young females with a graduate degree in psychology. Each child was tested in a quiet area in the school during school hours.

Children were audio and video taped for later scoring of total number of moves made, total time taken, rule breaks and self-talk using a small, unobtrusive video camera that was positioned at a 30-degree angle facing the child. The video camera was unobtrusive and children seemed not to be affected by it. The self-talk data included in the analyses was coded from the beginning of each test item until the child completed or discontinued the item, for all items the child attempted.
Scoring the TOL

Each item was given a score out of 3. A score of 3 was given when a child solved the problem during the first trial in the minimum number of moves. A score of 2 was given when a child solved the problem during the first trial but not in the minimum number of moves. A score of 1 was given when a child solved the problem during the second trial of an item. A score of 0 was given when the child failed both trials of an item. A total score was derived by summing the scores across the completed items.

Coding of Speech

Children’s speech during the TOL administration was coded from audio and video recordings. The speech was coded in terms of utterances. An utterance was defined as a length of continuous speech with less than a 2 second gap between words. Mean utterances per item was calculated by averaging the total number of utterances across the total number of TOL items attempted. The children’s utterances were coded for task relevance (planning or non-planning speech) and addressee (private or social speech) and inaudible muttering.

Task relevance/irrelevance. Task relevant utterances were all utterances that were directly related to solving the TOL. This could be utterances for formulating a plan, focusing and sustaining attention, evaluation or seeking assistance. Examples of task relevant utterances are: “the blue one goes here, no maybe there”, “I got to look at this very carefully”, “I need you to help me with this one”, “that was easy”, “tricky, tricky, tricky”. Utterances were coded as task irrelevant if they did not relate to the TOL such as remarks about the glove, “I like the glove”, descriptions of other activities, “I went to the library just now” or any other remarks about other events or people outside the testing context. Due to the small number of task irrelevant speech (2.5%), they were not analyzed.
**Addressee.** We followed Sturn and Johnston’s (1999) method of coding both private and social speech to be able to capture the full content of children’s planning speech. All utterances were deemed social speech when the child was interacting with the examiner. This was operationally defined as having any one or a combination of these elements:

- Eye contact or eye gaze
- Using the examiner’s name
- Asking a question and waiting for a response from the examiner or
- Initiating physical proximity such as touching the examiner’s hand or leaning towards the examiner.

An utterance was coded as private speech after looking for evidence of social speech and finding no evidence of social intent.

Inaudible muttering: This was coded separately to private speech. Inaudible muttering was operationally defined as any whispering, muttering, barely audible lip movements or silent lip movements.

**Inter-rater reliability**

A graduate student rater, trained with the coding criteria by the first author, independently coded a random 25% of the video and audio recordings for task relevance and addressee – private speech, social speech or inaudible muttering. In addition, each instance of task relevant private and social speech was further coded in terms of four content categories consisting of formulating a plan, focusing and sustaining attention, evaluation, and seeking assistance. Thus, there were nine different speech categories (including inaudible muttering). The total number of utterances classified into each category for each child was calculated for both raters. Inter-rater reliability was then calculated for each speech category by correlating the total number of utterances identified for each child across the two raters. These ranged from $r = .761-.998$. An
Results

Data Screening

TOL scores were log transformed to correct for unequal variance across groups. Analyses were then performed on both the raw scores and the transformed scores. The same pattern of results emerged in both analyses, and so, for ease of interpretation, the analysis performed using raw scores is presented. All variables met criteria for normality (i.e., skewness < 2 and kurtosis < 7; (Schmider, Ziegler, Danay, Beyer, & Bühner, 2010). An alpha level of .05 was used in all inferential statistics unless otherwise stated.

Group Comparisons on Matching Variables

The SLI and TD groups were matched in terms of age, \( t(170) = 1.67, p = .10 \) Cohen’s \( d = 0.26 \), but they differed significantly in nonverbal IQ score \( t(170) = 3.37, p = .001 \), Cohen’s \( d = 0.52 \). Due to this difference, nonverbal IQ was entered as a covariate in all subsequent analyses involving language group comparisons. The language scores, age and nonverbal IQ are not different between children with hyperactive and inattentive behaviours and those without these behaviours in both language groups (all \( p > .10 \)).

Group Comparisons on TOL Performance

To examine the TOL performance of SLI and TD children across grade levels, a 2 (language group: SLI, TD) x 3 (grade level: Kindergarten, Preprimary, Year 1) ANCOVA was conducted on the TOL total scores, with nonverbal IQ scores entered as a covariate. This analysis revealed a significant main effect of language group, \( F(1,165) \)
= 23.15, \( p < .001, \eta^2_p = 0.12 \), with children with SLI performing worse than TD children. There was also a significant main effect of grade level, \( F(2,165) = 20.36, \ p < .001, \eta^2_p = 0.20 \). Post-hoc contrasts revealed that the Preprimary children performed significantly better than the Kindergarten children, contrast estimate = -7.36, \( p < .001 \), but there was no difference between Preprimary and Year 1, contrast estimate = -1.43, \( p = .353 \). There was no significant interaction between language group and grade level, \( F(2,165) = 2.06, \ p = .130, \eta^2_p = 0.024 \), indicating that children with SLI were impaired relative to TD children across all grade levels. Figure 1 presents the means and 95% confidence intervals (CI) for each language group across grade level.

Figure 1: TOL total score (Mean & 95% confidence interval) according to language group(SLI and TD children) and grade level (Kindergarten, Preprimary, Year 1).

**Group Comparisons on Self-talk during the TOL**

**All Self-talk (Inaudible Muttering, Private Speech and Social Speech)**

To examine self-talk during the TOL for TD children and those with SLI across grade levels, a 2 (language group: SLI, TD) x 3 (grade level: Kindergarten, Preprimary, Year 1) ANCOVA was conducted on the Mean Utterance per Item collapsed across all types of self-talk (Inaudible Muttering, Private Speech and Social Speech), with
nonverbal IQ scores entered as a covariate. This analysis revealed a significant main effect of language group, $F(1,164) = 4.46$, $p = .036$, $\eta_p^2 = 0.03$, demonstrating that children with SLI produced less self-talk during the TOL compared to TD children. There was also a significant main effect of grade level, $F(2,164) = 4.18$, $p = .017$, $\eta_p^2 = 0.05$, which was moderated by a significant language group by grade level interaction $F(2,164) = 3.05$, $p = .050$, $\eta_p^2 = 0.04$, indicating a differential effect of grade level within each language group. A one-way analysis of grade level within the SLI group revealed no significant effect of grade level for children with SLI, $F(2,87) = 0.20$, $p = .818$, $\eta_p^2 = 0.01$. However, the same analysis showed significant differences across grade levels in TD children, $F(2,78) = 5.95$, $p = .004$, $\eta_p^2 = 0.13$. A repeated contrast revealed that Kindergarten children produced significantly more self-talk than Preprimary children, contrast estimate = 1.78, $p = .005$, but Preprimary and Year 1 children produced equivalent amounts of self-talk, contrast estimate = -0.021, $p = .970$. In addition, $t$-tests performed within each grade level revealed that TD children produced significantly more self-talk than children with SLI in Kindergarten, $t(58) = -2.66$, $p = .010$, $d = -0.71$, but not in Preprimary $t(46) = .02$, $p = .984$, $d = -0.06$ or Year 1, $t(61) = -0.71$, $p = .481$, $d = -0.18$. Means and standard deviations are presented in Table 2. To examine whether these effects were driven by inaudible muttering, private speech or social speech, a similar analysis was then performed for each type of self-talk individually.

1. **Inaudible Muttering only**

   For inaudible muttering, TD children produced more inaudible muttering than children with SLI, $F(1,164) = 127.63$, $p < .001$, $\eta_p^2 = 0.44$. There was no significant main effect of grade level, $F(2,164) = .93$, $p < .397$, $\eta_p^2 = 0.01$, and no significant interaction between language group and grade level, $F(2,164) = 0.06$, $p = .994$, $\eta_p^2 = 0.01$. However, the same analysis showed significant differences across grade levels in TD children, $F(2,78) = 5.95$, $p = .004$, $\eta_p^2 = 0.13$. A repeated contrast revealed that Kindergarten children produced significantly more self-talk than Preprimary children, contrast estimate = 1.78, $p = .005$, but Preprimary and Year 1 children produced equivalent amounts of self-talk, contrast estimate = -0.021, $p = .970$. In addition, $t$-tests performed within each grade level revealed that TD children produced significantly more self-talk than children with SLI in Kindergarten, $t(58) = -2.66$, $p = .010$, $d = -0.71$, but not in Preprimary $t(46) = .02$, $p = .984$, $d = -0.06$ or Year 1, $t(61) = -0.71$, $p = .481$, $d = -0.18$. Means and standard deviations are presented in Table 2. To examine whether these effects were driven by inaudible muttering, private speech or social speech, a similar analysis was then performed for each type of self-talk individually.
0.00, indicating that the effect of language group was the same across the three grade levels (refer to Table 2 for means and standard deviations).

2. Private Speech only

For private speech, the analysis revealed no main effect of language group, $F(1,164) = .70, \ p = .404, \ \eta^2_p = 0.00$, no significant main effect of grade level, $F(2,164) = 1.11, \ p = .334, \ \eta^2_p = 0.01$, and no significant interaction between language group and grade level, $F(2,164) = 1.44, \ p = .240, \ \eta^2_p = 0.02$, indicating that private speech is unlikely to be driving the language group difference evident in the main analysis.

3. Social Speech only

For social speech, there was no difference in the mean utterance of social speech per item between SLI and TD children, $F(1,164) = 0.40, \ p = .527, \ \eta^2_p = 0.00$. However, there was a significant main effect of grade level, $F(2,164) = 9.02, \ p < .000, \ \eta^2_p = 0.10$, which was moderated by a significant interaction between language group and grade level, $F(2,164) = 3.45, \ p = .034, \ \eta^2_p = 0.04$. Further analysis revealed a non-significant effect of grade level for the SLI group, $F(2,87) = 2.09, \ p = .129, \ \eta^2_p = 0.05$, and a significant effect of grade level for the TD group, $F(2,78) = 11.33, \ p < .001, \ \eta^2_p = 0.23$. For the TD children, Kindergarten children produced significantly more social speech than Preprimary children, contrast estimate $= 0.94, \ p = .001$, but there was no significant difference between Preprimary and Year 1 children, contrast estimate $= 0.24, \ p = .352$. In addition, $t$-tests revealed no significant differences in social speech between children with SLI and their TD peers in Kindergarten, $t(58) = -1.21, \ p = .231, \ d = 0.32$, or Year 1, $t(61) = 1.51, \ p = .137, \ d = 0.39$, but a significant difference between the language groups in Preprimary, $t(46) = 2.52, \ p = .015, \ d = 0.80$, with children with SLI producing more social speech than TD children.
Table 2

Means and Standard Deviations for Mean Utterance per Item for Inaudible Muttering, Private Speech and Social Speech in TD and Children with SLI

<table>
<thead>
<tr>
<th>Group</th>
<th>n</th>
<th>Mean utterance per item overall (SD)</th>
<th>Mean utterance IM per item overall (SD)</th>
<th>Mean utterance PS per item overall (SD)</th>
<th>Mean utterance SS per item overall (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SLI</td>
<td>90</td>
<td>2.04 (1.95)</td>
<td>0.05 (0.18)</td>
<td>0.94 (1.18)</td>
<td>1.08 (1.17)</td>
</tr>
<tr>
<td>K</td>
<td>35</td>
<td>2.13 (2.47)</td>
<td>0.04 (0.26)</td>
<td>0.85 (1.17)</td>
<td>1.19 (1.58)</td>
</tr>
<tr>
<td>PP</td>
<td>24</td>
<td>2.15 (1.53)</td>
<td>0.01 (0.05)</td>
<td>0.85 (1.00)</td>
<td>1.33 (0.91)</td>
</tr>
<tr>
<td>Y1</td>
<td>31</td>
<td>1.86 (1.53)</td>
<td>0.02 (0.09)</td>
<td>1.11 (1.31)</td>
<td>0.73 (0.64)</td>
</tr>
<tr>
<td>Hyp</td>
<td>30</td>
<td>2.47 (2.05)</td>
<td>0.05 (0.12)</td>
<td>1.38 (1.41)</td>
<td>1.00 (1.24)</td>
</tr>
<tr>
<td>NonHyp</td>
<td>60</td>
<td>1.83 (1.88)</td>
<td>0.05 (0.20)</td>
<td>0.72 (0.98)</td>
<td>1.10 (1.14)</td>
</tr>
<tr>
<td>TD</td>
<td>81</td>
<td>2.37 (2.25)</td>
<td>0.66 (0.45)</td>
<td>1.13 (1.59)</td>
<td>0.91 (1.08)</td>
</tr>
<tr>
<td>K</td>
<td>25</td>
<td>3.92 (2.70)</td>
<td>0.71 (0.50)</td>
<td>1.55 (1.86)</td>
<td>1.66 (1.34)</td>
</tr>
<tr>
<td>PP</td>
<td>24</td>
<td>2.14 (1.78)</td>
<td>0.62 (0.50)</td>
<td>0.81 (1.33)</td>
<td>0.72 (0.76)</td>
</tr>
<tr>
<td>Y1</td>
<td>32</td>
<td>2.16 (1.83)</td>
<td>0.65 (0.38)</td>
<td>1.01 (1.51)</td>
<td>0.47 (0.72)</td>
</tr>
<tr>
<td>Hyp</td>
<td>11</td>
<td>2.70 (2.25)</td>
<td>0.74 (0.44)</td>
<td>0.73 (0.63)</td>
<td>0.95 (0.72)</td>
</tr>
<tr>
<td>NonHyp</td>
<td>70</td>
<td>2.74 (2.37)</td>
<td>0.65 (0.45)</td>
<td>1.20 (1.68)</td>
<td>0.90 (1.13)</td>
</tr>
</tbody>
</table>

Note: SD = Standard Deviation, K=Kindergarten, PP=Preprimary, Y1=Year 1, Hyp=Children with Hyperactive and Inattentive Behaviours, NonHyp: Children with No Hyperactive and Inattentive Behaviour, IM=Inaudible Muttering, PS=Private Speech, SS=Social Speech
Hyperactive and Inattentive Behaviours and Performance on the TOL

To examine the TOL performance of SLI and TD children with and without hyperactive and inattentive behaviours, TOL total scores were collapsed across grade level for each language group to ensure adequate sample sizes within each group. A 2 (language group: SLI, TD) x 2 (behaviour group: hyperactive/inattentive and non-hyperactive/non-inattentive) ANCOVA was performed on TOL total scores, with nonverbal IQ entered as a covariate. Consistent with the previous analysis, there was a significant main effect of language group, $F(1,167) = 23.43, p < .001, \eta_p^2 = .123$. There was also a significant main effect of behaviour group, $F(1,167) = 4.68, p = .032, \eta_p^2 = 0.027$, with non-hyperactive/non-inattentive children performing better than hyperactive/inattentive children. However, this main effect was moderated by a significant language group by behaviour group interaction, $F(1,167) = 4.01, p=.047, \eta_p^2=0.02$. As can be seen in Figure 2, within the SLI group, children with hyperactive/inattentive tendencies performed significantly worse on the TOL than their non-hyperactive/non-inattentive counterparts, $t(89) = 3.20, p = .002, d = 0.72$. In contrast, for the TD group, there was no difference in TOL performance between children with or without hyperactive and inattentive tendencies, $t(79) = 0.53, p = .599, d = 0.12$. In addition, children with SLI without hyperactive and inattentive behaviours performed significantly worse than TD children without hyperactive and inattentive behaviours, $t(128) = -3.97, p <.001 d = 0.70$, and children with SLI and hyperactive and inattentive behaviours performed significantly worse than TD children with hyperactive and inattentive behaviours, $t(36.65) = -4.37, p =.003, d = -1.14$, indicating that the presence of SLI had a detrimental impact on TOL performance even in the absence of hyperactive and inattentive behaviours. Means and standard deviations are presented in Figure 2.
Given that past research has found that children with elevated levels of hyperactivity and inattentiveness tend to commit more rule breaks while completing the TOL task than non-hyperactive/non-inattentive children (Culbertson & Zillmer, 1998), an analysis was conducted to examine whether rule breaks might explain the differences in TOL performance found between children with SLI with and without hyperactive and inattentive behaviours. This analysis revealed that children with SLI with hyperactive and inattentive behaviours committed significantly more rule breaks than children with SLI without hyperactive and inattentive behaviours ($M = 24.8$ and $11.2$ for children with SLI with hyperactive and inattentive behaviours).
Hyperactive and Inattentive Behaviours and Self-talk during the TOL

We further explored the self-talk of children with and without hyperactive and inattentive behaviours by conducting a 2 (language group: SLI, TD) by 2 (behaviour group: hyperactive/inattentive, non-hyperactive/non-inattentive) ANCOVA on Mean Utterance per Item (collapsed across all types of self-talk) with nonverbal IQ as a covariate. This analysis revealed no significant main effect of language group, $F(1,166) = 1.08, p = .300, \eta^2_p = 0.01$, nor a main effect of behaviour group, $F(2,166) = 0.13, p = .721, \eta^2_p = 0.00$, and no significant interaction, $F(1,166) = 1.35, p = .246, \eta^2_p = 0.01$, indicating no significant differences in self-talk between children with SLI and TD children with and without hyperactivity and inattentive behaviours. Means and standard deviations are presented in Table 2.

However, due to the significant differences in the TOL performance of children with SLI with and without hyperactive and inattentive behaviours, which may suggest different self-talk in this group, we further analyzed the different types of self-talk individually between children with and without hyperactive and inattentive behaviours within the SLI group. Independent samples $t$-tests conducted on the Mean Utterance per Item for inaudible muttering, private speech and social speech revealed no significant differences between the two behaviour groups in inaudible muttering, $t(88) = -0.05, p < .957, d = -0.01$, or social speech, $t(88) = 0.17, p = .867, d = 0.05$. However, children with SLI with hyperactivity and inattentive behaviours had significantly more private speech than those without hyperactivity and inattentive behaviours, $t(88) = -2.67, p < .009 d = -0.60$. 
Relationship between Self-talk and Item Performance on the TOL

Lastly we examined whether children do better or worse (or the same) on the TOL when they use self-talk compared to when they are silent, and whether this was related to language group. Following Winsler and Naglieri (2003), we did this by calculating for each child two proportions: 1) the proportion of items with self-talk that were completed correctly, and 2) the proportion of items completed silently that were completed correctly. These indicate the probability of getting an item right with self-talk and when silent. The averages of these within-child proportions are listed in Table 3. The results indicate that for children with SLI, a higher percentage performed better on the TOL when they used self-talk compared to when they were silent. However, for most TD children, their TOL performance was not different if they had self-talk or were silent.
<table>
<thead>
<tr>
<th></th>
<th>Overall Sample (n=171)</th>
<th>SLI Group (n=90)</th>
<th>TD Group (n=81)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>(SD)</td>
<td>M</td>
</tr>
<tr>
<td>TOL Performance**</td>
<td>31.19</td>
<td>(9.62)</td>
<td>27.57</td>
</tr>
<tr>
<td>Number of Items with self-talk **</td>
<td>9.37</td>
<td>(5.18)</td>
<td>7.62</td>
</tr>
<tr>
<td>Percentage of Children who had at least one self-talk</td>
<td>80.70%</td>
<td></td>
<td>84.44%</td>
</tr>
<tr>
<td>Percentage of Children who had No self-talk (always Silent)</td>
<td>19.30%</td>
<td></td>
<td>15.56%</td>
</tr>
<tr>
<td>- Proportion of items correct*</td>
<td>.77</td>
<td>(.29)</td>
<td>.61</td>
</tr>
<tr>
<td>Percentage of children who were never silent (always had self-talk)</td>
<td>9.94%</td>
<td></td>
<td>8.88%</td>
</tr>
<tr>
<td>Proportion of items correct**</td>
<td>.88</td>
<td>(.26)</td>
<td>.75</td>
</tr>
<tr>
<td>Percentage of children that sometimes have self-talk and sometimes don’t</td>
<td>70.76%</td>
<td></td>
<td>75.56%</td>
</tr>
<tr>
<td>Proportion of items with self-talk that were correct**</td>
<td>.86</td>
<td>(.28)</td>
<td>.78</td>
</tr>
<tr>
<td>Proportion of items correct when silent**</td>
<td>.89</td>
<td>(.21)</td>
<td>.81</td>
</tr>
<tr>
<td>Percentage of Children whose performance was:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Better with self-talk</td>
<td>24.60%</td>
<td></td>
<td>40.98%</td>
</tr>
<tr>
<td>Better without self-talk</td>
<td>25.40%</td>
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<td>29.51%</td>
</tr>
<tr>
<td>The same</td>
<td>50.00%</td>
<td></td>
<td>29.51%</td>
</tr>
</tbody>
</table>

Note: ** Group difference significant at $p<.001$, * Group difference significant at $p<.05$
Discussion

The first aim of this study was to examine the planning performance and self-talk of young children with SLI (4-7 years) compared with their TD peers, and in particular, the changes in children’s planning performance across the first three years of schooling (Kindergarten, Preprimary and Year 1). The results showed that children with SLI performed more poorly on the TOL than their typically developing peers. This is consistent with previous studies showing that children with SLI have impairments in some areas of executive functioning (Bishop & Norbury, 2005; Finneran, et al., 2009; Henry, et al., 2012; Lidstone, et al., 2012; Marton, 2008), and particularly with the studies of Marton (2008) and Lidstone et al. (2012), showing that children with SLI have problems with planning and problem solving on complex cognitive tasks such as the TOL. Our study extended this previous research by demonstrating that the difficulties with planning and problem solving experienced by children with SLI are evident from a very young age. The results also showed that although performance improved across grade levels for both groups of children, children with SLI were impaired relative to their TD peers at each grade level. Figure 1 shows that the average performance of children with SLI in Preprimary and Year 1 was similar to the performance of TD children in Kindergarten. This suggests that the planning and problem solving ability of children with SLI may be lagging behind their TD peers by up to two years during the early years of schooling. Moreover, previous research that has examined planning in children with SLI during middle childhood (7-12 years) suggests that these children may continue to lag behind their TD peers throughout primary school (Lidstone, et al., 2012; Marton, 2008). The fact that such a gap in performance is evident at such a young age is concerning and longitudinal research tracking the developmental trajectory of planning and problem solving skills in children
with SLI from early years through to middle childhood is warranted to investigate the extent and duration of this delay.

In relation to self-talk, an important finding from this study was that TD children displayed significantly more self-talk than children with SLI during the TOL. This was especially evident in Kindergarten, but not in the higher grade levels. In addition to this, TD children exhibited significantly more inaudible muttering compared to children with SLI who had almost no inaudible muttering (refer to Table 2 for means of language group within the grade levels). This shows that even at a very early age, TD children have inaudible muttering, which is a sign of self-talk internalization. Thus, not only are they using self-talk but also showing signs that they are internalizing their self-talk to form complete verbal thought. In contrast, children with SLI seem to have a delay in inaudible muttering, which may be an indication of an overall delay in self-talk development.

Both TD and children with SLI displayed the same amount of private speech during the TOL. Consistent with the findings of Lidstone et al. (2012), this indicates that children with SLI possess and are able to use private speech for planning and problem solving. However for social speech, again we saw an interesting pattern. TD children followed the expected developmental pattern, with Kindergarten children displaying more social speech than Preprimary and Year 1 children, indicating that as TD children age, they use less social speech (an immature form of self-talk) and progress on to inaudible muttering. However, this was not the case for children with SLI who had the same amount of social speech across the three grade levels, and significantly more social speech than their same aged TD peers in Preprimary. Taken together, the results point towards a delay in self-talk development in children with SLI as they appear to rely on social speech, a less mature form of self-talk, throughout the three grade levels instead of using inaudible muttering, which they clearly lack. These
results are in line with both Sturm and Johnston (2009), showing that young children with SLI have less self-talk overall, and Lidstone et al. (2012) showing that children with SLI have a delay in self-talk development and internalization. Our study has extended these previous works by looking at the different types of self-talk which provides further insight into the nature of the self-talk delay in young children with SLI.

The second aim of this study was to examine whether planning performance was associated with levels of hyperactivity and inattention in both children with SLI and their TD peers. The results indicated that children with hyperactive and inattentive behaviours did perform more poorly on the TOL than children without hyperactive and inattentive behaviours, however, this was only the case for children with SLI. Within the TD group, there was no difference in planning performance between children with hyperactive and inattentive behaviours and those without. The results for the children with SLI were consistent with the previous research, but the results for the TD were not (Corkum, et al., 2008; Willcutt, et al., 2005), which has been attributed to delayed self-regulatory speech (Berk & Potts, 1991; Winsler, Manfra, et al., 2007). However, it is important to note that the children in our sample classified as having hyperactive and inattentive behaviours were not diagnosed with ADHD, but were classified on the basis of elevated levels of hyperactivity on the SDQ. Thus, the levels of hyperactivity and inattention evident in the present study may be milder than those evident in studies of children diagnosed with ADHD, which may translate into milder cognitive sequelae for the TD children in our sample. Nonetheless, the results clearly indicate that the presence of hyperactive and inattentive behaviours further impedes the already impaired planning and problem solving performance of children with SLI, and suggests that having a specific language impairment and hyperactive and inattentive behaviours may result in a ‘double deficit’ for these children.
The differential impact of hyperactivity and inattention in children with and without SLI is intriguing. One possible explanation is that children with SLI and hyperactive and inattentive behaviours are limited in terms of the compensatory strategies available to them to help them stay on track, plan and problem solve. We know that ADHD children exhibit delayed self-regulation (Barkley, 1997, 2001). Therefore, having hyperactivity comorbid with a language impairment may result in greater problems with using language for planning and sustaining attention on the complex cognitive task, leading to poorer performance for these children. For this reason, we looked at the self-talk of children with and without hyperactivity and inattentive behaviours in both the TD and SLI group.

In terms of self-talk, we found no difference in the overall mean number of utterances of self-talk in children with and without hyperactive and inattentive behaviours in either language group. However, further analysis revealed that within the SLI group, children with hyperactive and inattentive behaviours had more private speech than children without hyperactive and inattentive behaviours. There were no differences in inaudible muttering or social speech. Higher amounts of private speech in children with SLI with hyperactive and inattentive behaviours is in line with previous studies on self-talk in TD children with ADHD, which shows that these children have more private speech than those without hyperactivity and inattention, even though their performance is still lower than children without ADHD (Winsler, Diaz, et al., 2000; Winsler, Manfra, et al., 2007). Researchers (Barkley, 2001; Berk & Potts, 1991; Winsler, Diaz, et al., 2000) have argued that the reason why hyperactive and inattentive children have more self-talk during planning and problem solving is because they need to use self-talk to regulate their behaviour so that they are able to focus on the task at hand. Therefore, these children use self-talk for two functions: behavioural self-regulation and the cognitive task at hand. Thus, although having more private speech,
their performance on planning may still be lower as they need to divide their cognitive resources for these two concurrent functions. Given that up to 45% of children with SLI exhibit some degree of hyperactive and inattentive behaviours, more attention should be directed to this group to further our understanding of this double deficit and its impact on their self-talk and executive functioning.

The final aim of this study was to examine whether self-talk was related to performance on the TOL. Within the SLI group, a higher percentage performed better when they used self-talk compared to when they were silent. For the majority of typically developing children, it did not matter if they were silent or talking. However, TD children outperformed children with SLI regardless of whether they were talking or silent. This observation raises an interesting question as to whether TD children who were silent were using silent verbal thought (i.e., not exhibiting signs of self-talk as it is fully internalized) while children with SLI who were silent lack verbal thought to support performance on the TOL. This question warrants further investigation as we observed that children with SLI displayed virtually no inaudible muttering, which is an indication of self-talk being internalized. If this is the case, then children with SLI who were silent may not be using verbal mediation as a strategy during planning and problem solving tasks compared to children with SLI that have private speech or social speech. Some support for this suggestion comes from the finding that of those children that used self-talk sometimes but not always, for children with SLI, a higher percentage performed better on the TOL when they used self-talk than when they didn’t, whereas the opposite pattern was observed for TD children.

The results of this study have several clinical implications. First, it is essential that behavioural screening for hyperactivity and inattention for children with SLI is carried out in preschool. Given the combined impact of SLI and hyperactive and inattentive behaviours, an assessment of behaviour would provide an important insight
that parents and teachers could use to guide intervention and further assessment and diagnosis. It is important to note that we did not diagnose ADHD; this was not our aim. Our purpose was to determine whether, even at subclinical levels, having hyperactive and inattentive behaviours and SLI would impair planning and problem solving performance to a greater extent than having only SLI. This proved to be the case. Geurts and Embrechts (2008) also suggested that Children with SLI should be screened for ADHD as they found that in TD children, ADHD characteristics, particularly impulsivity, were associated with poorer language and communication development. Thus, future studies examining the effects of a comorbid diagnosis of ADHD and SLI and its impact on planning and problem solving in young children are warranted.

Second, our study highlights the importance of conducting early assessments of executive functioning, especially planning and problem solving, in children with SLI. This is particularly useful in the early years to enable the provision of appropriate intervention programmes for children with SLI. This is important because executive function deficits, especially a weakness with planning and problem solving, may be one underlying factor contributing to a number of the learning and social skills deficits that children with SLI often demonstrate during primary and secondary school. Executive function deficits including deficits in planning and problem solving have been shown to be associated with impaired academic performance (Biederman et al., 2004; Bull & Scerif, 2001; Latzman, Elkovitch, Young, & Clark, 2010), social skills (Blakemore & Choudhury, 2006) and poorer emotional regulation (Gioia, Isquith, Guy, & Kenworthy, 2000) in children and adolescents. Given the link between executive functioning and academic, social and emotional well-being in children, the situation for children with SLI, especially those with hyperactive and inattentive behaviours, is concerning. Previous research on older children with SLI indicates that they perform lower on virtually every academic task (Cohen, Barwick, Horodezky, Vallance, & Im, 1998;
Donlan, et al., 2007; Young et al., 2002) and display poorer emotion regulation and social skills (Botting & Conti-Ramsden, 2000; Cohen & Menna, 1998). Early intervention and continued monitoring may assist children with SLI develop planning and problem solving skills needed for more complex social interactions as they age.

Third, when examining the relationship between self-talk and performance on the individual items on the TOL, we found that in children with SLI, those who had self-talk did better than children who were silent, supporting Vygotsky’s notion that self-talk is paramount in cognitive tasks. Self-talk interventions and verbal scaffolding have also proven to be useful for TD children in enhancing their planning and problem solving abilities (Winsler, 2009). Therefore, self-talk training may be useful for children with SLI to assist them in their self-talk development. This is one area for early intervention as verbal self-regulation has been shown to be useful not only for cognitive tasks but also in social interaction and emotional regulation in both children and adults (Diaz & Berk, 1995; Diaz, et al., 1992).

Our study has several limitations. First, it used a cross-sectional design and did not follow the planning performance of the same group of children over time. Consequently, the changes across age needs to be assessed using longitudinal studies to examine the developmental trajectory of planning performance in young children with SLI to confirm that the apparent delay in development is not simply a cohort effect. In addition, it would be valuable to follow the children beyond Year 1. This would offer more insight into the pattern of development of the planning ability of Children with SLI across childhood. In addition, future studies in this area should include more participants within both language groups to enable comparisons of children with and without hyperactive and inattentive behaviours within each grade level. Although the relative numbers correspond to the proportion occurring in the population, the small numbers limited our ability to look at hyperactivity and inattention within each grade.
level. Future research in this area would need to increase the number of hyperactive and inattentive children to be able to do grade level comparisons. As we did not test the children’s language directly, we do not know if children with SLI with primarily receptive or expressive or both expressive and receptive impairments may differ in their self-talk and planning and problem solving performance. Thus, future studies need to assess and categorize the diagnosis of SLI as mainly receptive language impairments, mainly expressive language impairments or a combination of both to examine possible differences in self-talk and executive functioning within the SLI population.

As noted before, the children in our study were younger than those in previous studies using the TOL. We also used a TOL set that ranged in difficulty from 2-move to 7-move problems. As we discontinued the test after three consecutive failures, which was necessary given the age of the children, not all children completed all the TOL items. Children in the SLI group, particularly younger children and those with hyperactivity and inattentive behaviours, had the most difficulty and thus stopped earlier. This resulted in children stopping at different levels of difficulty and so it was not possible for us to make meaningful inferences regarding the time taken to complete problems and number of moves.

**Conclusion**

The present study makes a significant contribution to our understanding of self-talk changes across age during a complex cognitive task that involves planning and problem solving ability in young children with SLI. It shows that Children with SLI perform more poorly on the TOL than typically developing children and that this deficit persists across the first three years of school. This study also highlights the differences in self-talk between children with SLI and their TD peers showing that there is a delay in self-talk development in children with SLI that warrants addressing. These findings
suggest that an intervention using self-talk training for children with SLI when planning and problem solving may be useful for children with SLI, as they appear to have self-talk, but are not using it as much or as effectively as their TD peers. This study also indicates that children with SLI and hyperactive and inattentive behaviours may have a double deficit which exacerbates their difficulties with planning and problem solving. It brings to attention a subset of children with SLI, namely, those with hyperactive and inattentive behaviours, that requires further, more comprehensive research. More broadly, the findings indicate that any assessment of executive functioning skills in children with SLI should take into account their behavioural issues, particularly hyperactivity and inattention, in addition to their language, including self-talk.
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Chapter 3

Talk to Think

A Play-Based Self-talk Training Manual to Scaffold Self-Talk In Young Children with Specific Language Impairment

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The University of Western Australia

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Talk to Think

(T2T)

A Play-Based Self-talk Training Manual to Scaffold Self-Talk In Young Children

with Specific Language Impairment

Safiyyah Abdul Aziz

Janet Fletcher
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Introduction

This Talk to Think (T2T), self-talk training manual is designed for psychologists working in schools and educational settings. It can also be used by speech pathologists, teachers and parents providing the role of therapist. This intervention is designed for children aged 4-7 years old with Specific Language Impairment (SLI), who have been shown to have a delay in self-talk development (Abdul Aziz, Fletcher, & Bayliss, under review; Lidstone, et al., 2012; Sturn & Johnston, 1999). It may also be suitable for older children with language delays. It is designed to be a group intervention but can easily be tailored to a one-on-one session if necessary.

The T2T programme is based on Vygotskian theoretical foundations of verbal mediation for cognitive and executive processing for the process (Diaz & Berk, 1995; Frauenglass & Diaz, 1985; Frawley & Lantolf, 1986; Moll, 1992; Vygotsky, 1987). It also incorporates Meichenbaum’s Self-Instructional Training main themes of cognitive self-guidance, self-corrections and self-reinforcements as the objectives (Meichenbaum, 1985; Meichenbaum & Goodman, 1971).

This T2T manual is best used as a whole to obtain a comprehensive intervention using the sequence of sessions outlined, as each session builds on the previous one. This Self-talk training emphasizes the involvement of teachers and parents to reinforce the intervention sessions in the classroom and at home through collaboration with the therapist. Both parents and teachers receive training materials for this purpose.

Vygotskian Foundations of the Talk to Think Programme

The five over-arching foundations of self-talk training derived from Vygotskian theory that are used in the T2T programme are: children are active learners, play is an effective way to develop language, planning and problem solving develops through language,
tasks within the zone of proximal development are optimal for learning, and adult sensitive scaffolding during social interactions assists children to improve their self-talk and planning and problem solving ability (Diaz & Berk, 1995; Moll, 1992; Vygotsky, 1987).

The first Vygotskian principle adopted by the T2T is that children are active participants in the learning process. We involve children during the learning process on the premise that their participation in the learning activity enhances their comprehension and retention. The learning process is a two-way process with interpersonal communication between the adult and child.

The second Vygotskian principle adopted by the T2T is that young children learn best through play. Play is central during the early years of childhood and much social interaction and communication happens during play. Language development improves during social play (Vygotsky, 1967). Thus, having a play-based self-talk intervention for young children with SLI may help them with their self-talk development. Play is natural for children and a positive environment during play will further motivate children towards higher challenges.

Third, Vygotsky and his colleagues (1978) believed that language used in the social environment is important for developing higher psychological functions, or executive functions, such as reasoning, self-regulation, planning, problem solving and goal monitoring. As children age, they use language not only to communicate with others but also to communicate with themselves to plan and monitor their activities. The use of ‘speech for the self’ as Vygotsky termed it, expands children’s problem solving capabilities as it reduces the impulsivity of immediately responding to the current stimulus by providing a mechanism through which children are better able to pause and think about their actions. They can plan a solution to a problem prior to attempting a task and can self-regulate and control their behaviour internally.
Fourth, Vygotsky and Neo-Vygotskian researchers have agreed that tasks that are within the zone of proximal development (ZPD) are at the optimum level for children to develop a new skill (Luria, 1976). ZPD is defined as the distance between the current level of development and the potential level of development (Luria, 1976). This means that during intervention, such as this self-talk training programme, the tasks chosen for children (e.g., Lego building) need to be within the ZPD. That is, the task should not be so easy that a child can do it independently without help, but instead, the child should be able to do some of the task, but not fully, and will require some guidance from an adult. Thus, adult scaffolding during this time will help children learn and develop to achieve a higher level in their understanding. Tasks within the ZPD are also crucial to encourage self-talk and to demonstrate to children how they can use self-talk when a task gets challenging (Moll, 1992).

Fifth, Vygotskian theorists, particularly Luria (1976), strongly emphasized sensitive scaffolding. Scaffolding is defined as the gradual withdrawal of adult control and support as the child gains mastery over the task. In our T2T programme, emphasis is given to assisting the child to complete the task first through adult support and then gradually to be able to complete the task independently.

**Meichenbaum’s Principles of Self-Instructional Training**

As mentioned before, our T2T programme uses Vygotskian inspired processes. We also incorporated Meichenbaum’s five themes as the objectives of our programme. Meichenbaum and Goodman’s Self-Instructional Training is based on Luria’s self-regulatory stages (Meichenbaum & Goodman, 1971). There are five components to Self-Instructional Training as designed by Miechenbaum and Goodman: pay attention, inhibit / stop automatic responses to environmental stimuli, regulate behaviour and choose appropriate behaviour to be put in place, use rules and principles to guide behaviour and maintain a flow of action in
working memory (Meichenbaum, 1985; Meichenbaum & Goodman, 1971). The main steps by which Meichenbaum and Goodman’s training components are achieved are: stating the goal of the task, verbalizing errors and correction, using self-praise and providing positive feedback to the self (Meichenbaum, 1985; Meichenbaum & Goodman, 1971). We adopted the themes of Meichenbaum’s Self-Instructional Training for our objectives in the T2T programme because these are behaviours that are valued in a school setting and are important to enhance learning in children. Meichenbaum and Goodman had sound Vygotskian themes and steps but they implemented their Self-Instructional training using a cognitive-behavioural model that relied very heavily on modeling, rehearsing and fading techniques. Meichenbaum and Goodman modelled long scripts with the themes of his training imbedded in the script for the children to rehearse and follow. After repeating the script aloud while doing the task, children were then asked to do the task again but to sub-vocalize the script instead of saying it aloud. Therefore in the Self-Instructional Training the children were expected to use the verbalizations provided by an adult instead of using their own self-talk. This method was found ineffective as it placed more burden on children’s cognitive capacity and inhibited their own self-talk (Diaz & Berk, 1995). Therefore, although we used Meichenbaum and Goodman’s 5 components as objectives in the T2T Programme, we did not use his methods. Instead, we used the process advocated by Vygotsky, allowing children to use their own self-talk and utilizing sensitive scaffolding during the sessions with children.

**Overview of the T2T Programme**

**Self-talk training for children**

The objective of the T2T programme is to improve children’s self-talk during planning and problem solving through a collaborative play-based intervention. The T2T
programme is designed to be semi-structured, collaborative and to encourage verbalization from the children. Our T2T programme utilizes Lego building blocks as the main material to use during planning and problem solving. Lego building was considered suitable as it has a wide range of options that are suitable for different age groups, interests and ability levels and is useful in eliciting planning and problem solving language. The Lego building task should be chosen according to the children’s ages, interests and ability levels and can be sourced from Lego instruction manuals and the Lego education website, which offers a variety of Lego building options (www.legoeducation.com). Over the sessions the Lego building tasks are increased in difficulty level depending on the children’s performance. If Lego is unavailable, other building materials can be considered as well as art and craft activities.

The key principles of the T2T programme

Self-talk is a readily available problem solving tool that develops in children with age, although it is delayed in children with SLI (Abdul Aziz, et al., under review). The main basis of self-talk training is that it is built on the verbalizations and self-talk used by children during planning and problem solving. The sessions are a collaborative effort between the therapist and children with an emphasis on two-way interaction. The therapist needs to ensure that the children have a shared understanding of the objective and the task for the session. The sessions are dialogic and promote joint activity and discussion, with the therapist providing insights, instructions and scaffolding in ways that children can understand and use as a model.

As children gain mastery over the building task, the therapist slowly lets go of the regulatory role so that the children can take over solving the task, moving from interpersonal problem solving to using self-talk to solve the problem independently. There are no exact scripts to follow in the T2T programme, rather, the therapist builds on the self-talk of the
child, encourages it and scaffolds it to ensure that the child can move through the task by using their own self-talk.

Self-talk and task competence is dynamically related:

• Self-talk tends to emerge spontaneously in moments of difficulty (Diaz & Berk, 1995). With children with SLI, this may not be the case, therefore the therapist needs to be aware of this and to encourage self-talk during challenging moments.

• Children use self-talk to restore the flow of competent functioning after they encounter a challenge (Diaz & Berk, 1995). In children with SLI however, they tend to be silent when faced with challenges, thus the therapist needs to scaffold through leading questions, conversational prompts and by modelling self-talk so that the children can follow and later use self-talk strategies when they encounter subsequent challenges. It is important to remember that the self-talk modelled needs to be short phrases that are in the children’s language repertoire to be effective. More guidance is offered when children get stuck and less guidance when they are successful.

• Self-talk is useful to sustain attention when concentration levels drop or when a distractor is present. This is particularly a focus for children with SLI who have been identified as having issues with inattention and/or hyperactivity (Diaz & Berk, 1995).

• Self-talk can be used to recall the goal of an activity after a distraction. This is particularly important in a school setting where there are many external distractions in the classroom.

• Teach children self-talk strategies, rather than providing explicit scripts, to encourage them to use their own planning speech across other activities. Provide coping self-talk such as “I am stuck here, but it’s ok, let’s look back…” and scaffold so children can learn how to emit coping statements to help them with challenges.

• Encourage children with praise and encourage their self-praise (‘I did well! Yeay!’).
Building the therapist-child relationship

It is paramount that the children involved in the T2T programme are familiar with the therapist and are comfortable with the prospect of having many sessions with him/her. It is strongly advised that the therapist has made him/herself known to the children, whether through participating in a non-related classroom activity such as volunteering in the classroom or arranging a warm-up session with the children prior to the start of the intervention. We recommend that a week prior to the start of the self-talk training programme, children receive one 20-minute warm-up session with the therapist. It is up to the therapist to decide how to run the warm-up session. A session using paper-folding activities or other craft activity is suitable.

Collaboration with teachers and parents during T2T programme

If the therapist is not the teacher or parent of the target children (e.g., psychologist or speech therapist), it is important to keep in mind that the T2T programme, like other interventions involving young children, needs to have continued reinforcement and monitoring out of the sessions by other significant adults, usually the teachers and parents (Winsler, Carlton, & Barry, 2000; Winsler, et al., 2003; Winsler & Diaz, 1995). We strongly encourage collaboration with parents and teachers during the implementation of the T2T programme, as providing opportunities to use self-talk during planning and problem solving at home and in the classroom reinforces the knowledge gained during the T2T sessions. A week prior to the start of the self-talk training, parents and teachers of the children involved are given T2T programme handouts in printed form (see Appendix A) that explain self-talk training and how to encourage the use of self-talk in the classroom and at home. This material helps the parents and teachers understand the objectives and the principles of self-talk training. As the focus of the self-talk training is to improve planning and problem solving,
which are vital skills in the classroom, teachers are provided with additional information orally by the therapist explaining in more detail the theoretical and practical overview of the T2T programme and specific examples of how he/she can encourage the use of self-talk in the classroom. Throughout the training period, parents should have access to the therapist and should be able to raise any questions or concerns with the therapist. They also should be sent reminders to use self-talk at home. This ensures continued collaboration among the therapist, teacher and parents. It is highly recommended that on the day of each self-talk training session, the therapist meets with the class teacher for about 15 minutes to go through the session aims and plan for the current session. This equips the teacher with the necessary information to scaffold and encourage self-talk in his/her classroom after the T2T session. This regular communication with the class teacher will ensure the continued scaffolding of self-talk for children with SLI.

**Outline of the T2T sessions**

The intervention is designed for small groups of 2-4 children aged 4-7 years old. There are a total of 10 sessions; two 30-minute sessions per week for 5 weeks in a separate room away from the classroom.

Each session starts with the therapist explaining the objective of the session and a recap of the previous session. Any issues that may have arisen in the classroom are also addressed. The therapist then introduces the task of the day and emphasizes how self-talk can be used. The therapist will then demonstrate how she would use self-talk during the task. After demonstration, children begin the tasks and the therapist scaffolds their self-talk and provides guidance on the task. The session ends with a summary and how to use self-talk at home and in class.
**Sessions 1 and 2:** The objective of the first week is to explain the importance of focusing and paying attention and listening to instructions and other peers who are participating. This is done by encouraging the use of the children’s self-talk for focusing and paying attention to the task at hand.

**Sessions 3 and 4:** These sessions bring an extra component to focusing and paying attention; that is, to sustain attention and re-focus attention when the children get distracted by external as well as internal distractions.

**Sessions 5 and 6:** The objective of these sessions is to develop a plan that is sequential (step-by-step plan in children’s words) to enable the development of a train of thought about a task. The focus is self-talk for planning.

**Sessions 7, 8 and 9:** These sessions are a follow-up from the previous week. More challenging Lego building is introduced for planning. The objectives of these sessions are to teach children to use their self-talk to recognize the challenges, be able to use self-talk when they feel challenged and be able to ask for help when they get stuck. To achieve this, the children are scaffolded to use self-talk to break down tasks, to be able to go back to a previous successful step and to re-examine the current problem. The therapist encourages the children to use self-talk to explain the current challenge, scaffolds their self-talk and works through the problem with them.

**Session 10:** The focus of this session is to summarize all the skills that the children have learnt and to provide them with a visual reminder of the T2T programme. In this session the therapist spends time talking about the importance of self-talk and how it has helped them.

*Please note that the scripts provided are examples of what the therapist may say in the sessions. They are NOT a script to follow. Rather, the therapist should scaffold the child’s self-talk by using the language within the child’s repertoire.*
Week 1

Sessions 1 and 2: Look and Listen, Pay Attention
Week 1

Sessions 1 and 2: Look and Listen, Pay Attention

Being able to self-regulate to focus on a task is vital in an academic setting. To be able to perform well on a task, children need to attend to the task and the instructions relating to the task. They also need to be able to sustain that attention and focus to complete the task.

The first two sessions of self-talk training centre on these skills, equipping children with the reasons why they need to focus on their task, listen and understand the instructions, pay and sustain attention throughout the task. There is also an emphasis of encouraging children to sustain attention while their peers are having a turn, as this is vital in a classroom setting.

Objective of the sessions

These sessions focus on teaching children to use self-talk to focus on the task at hand, listen to the instructor and to pay attention to the task. To achieve this objective, the therapist should:

- Explain and discuss self-talk, encourage verbalizations during the sessions.
- Encourage children to look at the Lego blocks and think about what they are going to have to do.
- Encourage children to verbalize their thoughts.
- Emphasize listening to instructions, understanding and comprehending the instructions. Being able to re-tell the instructions in their own words.
- Ensure children are paying attention during the task by using self-talk to focus and maintain focus.
Suggested items:

5-7 years old: 6166* Lego Box, laminated Lego pictures (see Figure 1 and 2)

4 years old: 6176* Duplo box, Laminated Duplo pictures

*The numbers represent the Lego codes on the box (refer to www.lego.com)

Figure 1: Tub of mixed up Lego

Figure 2: Laminated card
Session 1 task:

In this session, the children have to sort out and find the Lego pieces that correspond to the laminated pictures provided. Each child will pick a picture of a Lego piece (e.g., a red block with 4 bumps) which they will need to describe. Then each child will have to find all of the Lego pieces that match their picture from the jumbled up Lego tray which has many Lego pieces. They will be told how many pieces of that block there are in the container and have to look for them. They are encouraged to use self-talk to help them achieve the goal of collecting the number of pieces required.

Session 1 structure

i) Introduce and explain self-talk to young children

Below is an example of the flow of a first session when the therapist explains self-talk. It is important to note that there are no exact scripts to follow, and the language should be adjusted to children’s language level:

“Today I am going to teach you all something you all are already good at. Who can guess?” (Therapist gets answers from the children).

“I am going to teach you how to talk.” (If children giggle or say they know how to talk, acknowledge that.) “But, I am not going to teach you to talk to me, or your friends or your teacher. I am going to teach you to talk to yourself”. (Some children get a better idea about self-talk when you tell them to talk to their brain).

“Why do we need to talk to ourselves?” (Get answers from children).

“We do self-talk because it can help us listen, look and pay attention. So we can do our work better. When we can look and pay attention, we do everything better, both working and playing”.

“Okay, so today I will teach you what to say to yourself. We call this self-talk”. (Get them to say self-talk so they are used to the term). Take time to clarify the concept.

ii) Introduce session objectives
“Now who knows, what is the first thing we need to do before we start our work?” (Get answers from the children, elicit the notion to look at the task). “Yes, we have to look at it to know what we are going to do.”

“Then what? (Elicit the idea of listening to instructions). “We need to listen to the person giving the instructions, to know what we need to do.”

“So we tell ourselves using self-talk to look and listen” (Get children to say look and listen). “I’ve got to look and listen”. (Some children would prefer focus, or pay attention. This is fine). The main objective is to teach the children to self-talk to focus their attention. The children do not have to follow a script.

iii) Explain the task clearly

Take the Lego out. Start by asking, “What do you think we will do with the Lego? What should we do when the Lego is all mixed up?” (Elicit the idea of sorting the Lego into colours and shapes).

“This game is called look and find. We have to look carefully and pay attention to look for only the Lego that we want, like in the pictures here; each of you will look for a different piece. So you have to pay attention to look for only your piece.”

“When we play this game, we need to practice self-talk, so we can look for it better and faster.”

iv) Demonstrate self-talk during the task

Take a picture of the Lego piece and describe it, “Hmm, got to look for a blue bit like this square.”

“Ok… so, blue square… where are you. Look, look, look. aha.. yup got it”.

v) Get each child to describe their picture.

Scaffold the children’s use of self-talk, particularly when they are having difficulties finding the Lego pieces. “Are you stuck?” “What do you have to look for?” Reward self-talk with stickers.

vi) Turn take

Each child will take turns to look for their pieces until they have the number of pieces that they need.
vii) **Search for pieces together.**

After each child has had a turn, change their picture cards and now let them all search for their respective pieces at the same time. Ensure that they self-talk at the beginning and during the task. If a child appears lost, scaffold until they understand the task and are able to self-talk.

viii) **Recap and summarize**

At the end of the session, spend some time to recap and ask each child what self-talk they learnt today. Explain how they can apply self-talk to pay attention in the classroom. To ensure a high level of interest for the subsequent sessions, allow time for 5 minutes free play with the Lego.

**Session 2 task:**

This session is aimed at teaching each child to use self-talk to look, listen and pay attention. As this game is a little complex, each child will have to stay focused.

**Suggested Items:**

5-7 years old: 6166 Lego box, 15 pairs of 2 pieces of the same Lego, silicone cups and a checkered tea towel (see Figure 3).

4 years old: 6156 Duplo box, 10 pairs of the same Lego, Silicone cups and a checkered tea towel.
Task:

The Lego will be placed on the tea towel and covered with cups (this game is akin to playing pairs with cards). After the child manages to find a pair, they can stack them up, or build whatever shape they want. Those with the most pairs win. Depending on the time, the game can be played twice.
Session 2 structure

i) **Begin the session with a recap of the previous session**

Recap the previous session and also address any issues in the classroom relating to self-talk. Ask the children what they learnt from the first session. Reinforce their learning and correct misunderstandings. Repeat again if they appear lost.

ii) **Introduce today’s session**

“So today we are going to play another game. During this game we need to self-talk to help us to look and listen, so we can pay attention and do very well at the game.”

iii) **Explain the game clearly**

Start by using conversational prompts. Put the Lego as per the picture on the table and ask the children about the possible tasks, for example, “What do you think we will do with the Lego? How do you think we will play this game?”

iv) **Explain the rules of the game.**

“This game is called ‘Lego pairs’. Each one of you will get a turn to lift two cups and use your self-talk to tell yourself what is under that cup.”

“Others will look and use their own self-talk to remember what is under the cups. We will have to pay attention and remember which Lego piece is located under each cup.”

“Each time you are allowed to lift two cups. If the two cups have the same Lego, you can keep the Lego. If it has different Lego, you have to cover the Lego again with the cups.”

“You can use the Lego you get to build anything you want. The person who gets the most wins!” (Check for understanding, if they appear confused, explain again). Encourage children to verbalize the instructions and correct misunderstandings.

v) **Explain how to use self-talk to remember the Lego pieces**

“To help us look and remember the Lego piece better, we have to pay attention. Just like how the teacher tells you to pay attention, you can tell yourself to pay attention by talking to yourself.”

vi) **Demonstrate self-talk**

“I lift two cups. Got to find the right pair. Let me guess.”
“I will lift this, it is a red square and this is a blue door. Nope, not the same. But I remember what is under here and here. Red square and blue 2-bumps”. Get the children to self-talk as well to remember the two Lego pieces.

Encourage collaboration and focus on the task.

vii) **Play the game together with the children**

Ask the children questions about the game with conversational prompts, ensure comprehension, try to get them to think of strategies to win the game. Get them to verbalize and start the game.

Tell the children, “Now we will take turns. Let’s start. Remember to self-talk so you can pay attention and remember the Lego pieces”.

“Your turn…” Turn take with the children, play the game as a participant. Be sure to do self-talk when trying to recall items in the midst of the game. Scaffold and assist the children in their self-talk.

Ensure that the children talk to themselves, and if they don’t, encourage them to. Scaffold until the child can do the task independently. “Look, it is a blue wheel… and black block… Not right…” If they can do it, encourage them to do it with self-talk, if they complete a pairing quickly, repeat the game another time.

It is important to remember to teach the children to inhibit automatic responses from environmental stimuli. For example, if the child sees Lego pieces and just starts stacking them up without a guide, talk to them and teach them self-talk to reduce the automatic responses. Use environmental cues (e.g., door slamming, siren ringing) as resources in teaching them to inhibit automatic responses. Teaching this step should be incorporated in all sessions.

vii) **Summarize the session**

Describe how to apply the first step of self-talk in class and at home (e.g., when on the mat in class, always tell yourself to look and listen to the teacher so you can learn better).

As there are five steps to self-talk training, we teach children to remember each step using their fingers on one hand. So the first step, to look and listen, is on the thumb (see Figure 4).
Figure 4: To help children to remember the T2T steps. We use our five fingers. The first week uses the thumb to remember ‘Look and listen’.
Week 2

Sessions 3 and 4: Keep on Track
Week 2

Sessions 3 and 4: Keep on Track

Sessions 3 and 4 are a continuation of sustaining attention with an added emphasis of re-focusing attention once it is lost. Attention can be lost either due to the children’s own factors (spacing out, disinterest, low comprehension) or due to external environmental factors such as noise, school announcements on the PA system, peers in the classroom and the conversation of others. After being able to re-focus attention, children then need to learn to inhibit the impulse to attend to the recurrent distractions. Being able to re-focus attention, inhibit attention to distractions and continue to sustain attention on the task at hand is important because classrooms are filled with everyday distractions and this is an important skill which we can use self-talk to develop.

Objective of the sessions

These sessions aim to teach children to keep on track (focus and sustain attention) on the task at hand and inhibit environmental stimuli. To achieve these objectives, the therapist should:

- Make children aware of what leads to them being distracted in class.
- Teach them to use self-talk when they get distracted.
- Teach them to use self-talk to sustain attention.
- Encourage children to help peers to sustain attention together.

Suggested Items:

5-7 years old: 5932 house, 5932 car, helicopter, tree cat

4 years old: 7614 Giraffe, moose, tree, house, car and boat
Task: In this session, children will be doing the Lego building in a relatively busy place (e.g., common room), so that there will be noise and other people walking in and out. This session aims to teach children to come back to a task when there is a distraction.

Sessions 3 and 4 structure

i) Recap the first 2 sessions.
Remind the children by using our fingers. Ask them, “Who can remember what self-talk we learnt last week?”

Reward right answers with stickers. “Yes, we have got to self-talk to look and listen, so we can pay attention and know what to do.”

ii) Explain what an external distraction is
“In class, sometimes it is noisy. Why is it noisy?” (Get answers from children). “That’s right, your friends make noise, the bell rings, there is an announcement, or your friend chats with you.”

“What about at home? Is it noisy at home?” (Get answers from children). “Yes, your baby brother cries, the TV is on and many other things. When this happens, it makes it hard to keep on track to do our work.”

iii) Explain the current setting
“Last week, we had our Lego in a quiet room. Today we are going to make it in the common area, where there are other people coming in and out.”

“So it is very important that we self-talk to look and listen so we can keep paying attention. We have to keep on track and keep building our Lego.”

iv) Explain internal distraction from our own self
“Sometimes, it is not other people who are making it hard for us to pay attention. It is us. We may be dreaming, or thinking of something else, or looking at other people.”
“So we always need to self-talk to keep on track. So when we feel like we cannot look and listen and look away from our work, we need to self-talk to tell ourselves to keep on track.”

“Keep on track means keep on doing our work until we finish it. So the second kind of self-talk we are going to learn (indicate pointer finger on hand) is self-talk to keep on track.”

v) **Bring Lego and instructions out to begin building**

“Now we can start. Let’s look at the picture here. What are we going to build?” (Elicit answers from children).

“Yes, we are going to make some animals, a giraffe and a moose, and a tree and a house.”

“So now, what do we need to do first? Yes, we have to look carefully at the picture. How do we know how to build?” (Elicit from the children the idea of looking at the Lego instructions).

“Yes we have to do it step by step and look at the instructions so we know what to do. Now, let’s look at the steps, each of you will have a turn to do one step at a time. We need to self-talk to know what to do. The others who are watching need to keep on track so when your turn comes, you know how to do the next step.”

vi) **Demonstrate self-talk**

“To help us do it better, we need to self-talk loudly. I will show you.” Demonstrate the first step using self-talk. “Now, we are making a ___ What do I need? This piece…It goes here. What’s that? Look back here…Now the bottom part….”

vii) **Children’s turn to build**

Go through with each child each step that they have to make. Teach them to use self-talk to tell themselves what they have to build, what they need and where to put it. Encourage each child to self-talk before fixing the Lego and to keep on track as they go on. Scaffold and encourage the child to follow the step in the Lego instructions while using self-talk until they are able to place the Lego block correctly before moving on to the next child.

viii) **Ensure that the other children are paying attention**

If children are not paying attention, bring their attention back by asking, “What do you have to tell yourselves to do?”
Emphasize looking and listening, as well as keeping on track. It is very important to remember to be aware of all the distractions during this session and to teach the children to come back to the task by asking them to use self-talk.

ix) **Encourage each child to do their step on their own**

As children turn take building the Lego, encourage each child to complete their turn building the Lego by appropriate scaffolding, use leading questions and encouraging them to use self-talk while building.

x) **Reinforce the self-talk and the attention of the children**

After the building has been completed, reinforce the self-talk and the attention of the children. To keep level of interest in the sessions high, allow a few minutes for the children to play with the Lego before summarizing the session.

xi) **Summarize the session**

Summarize the session by telling the children to remember to self-talk using the two steps we have learnt. Look and listen as well as keep on track (see Figure 5).
Figure 5: This week’s main focus is sustaining attention and re-focusing after a distraction, to keep on track until children reach their goal.
Week 3

Sessions 5 and 6: Let’s Plan!
Week 3

Sessions 5 and 6: Let’s Plan!

In these two sessions, the focus is on using self-talk for planning. Using language is essential for planning and problem solving and in these sessions, the focus is to encourage children to use their own self-talk. Children are encouraged and their self-talk is scaffolded through the building task to maintain a train of thought to achieve the goal.

Throughout the sessions, children are encouraged to use their self-talk overtly to tell themselves what they need to do. They are prompted and encouraged to use self-talk with stickers and verbal praise. The therapist needs to be sensitive and provide leading questions and verbal prompts when the children are faced with challenges.

Objective of the sessions

These sessions aim to encourage and scaffold children to use their own self-talk during planning a building task. To achieve this objective, the therapist should ensure that:

- Children are using self-talk during planning.
- Scaffolding of self-talk is provided with leading questions and conversational prompts.
- Tasks are challenging enough for children to elicit self-talk.
- Children plan ahead and maintain a train of thought to plan their Lego building.
- Continued encouragements to use self-talk to pay and sustain attention are provided.

Suggested Items:

5-7 years old: 5932 Windmill, 5932 House, 5932 Car, 4628 House, 5932 Car, 6166 Mechanic garage, 5932 Mechanic truck, 6166 Hut, Helicopter and Car.
Task:
In this session children build various items using Lego. While doing this they have to use self-talk and ask themselves what they need to do to build the Lego objects.

Sessions 5 and 6 structure
i) Recap the previous sessions

“Who remembers what we have learnt so far?” (Elicit answers from children and reward correct answers with stickers and praise). “Yes, the two steps are: look and listen, pay attention and keep on track.”

Explain briefly what they mean. “Look and listen means we have to self-talk to tell ourselves to look at our work and listen to instructions so we know what to do. Keep on track means we keep going on with our work until we finish it.” (If children appear lost or confused, spend some time explaining and recalling the previous sessions).

ii) Introduce this session’s objectives

“Today we are going to learn a new step. When we are going to build something, or do a project, we need to know what we have to do first. This is called a ‘plan’.”

“So when we do our work, we need to use self-talk to tell ourselves what we are doing so we can keep on doing it until we finish.”

“When we forget, or get distracted, we can always use self-talk and ask ourselves: What am I doing? What to do now? Oh, I am doing the ___, and keep on doing it. So remember to tell yourself what you are supposed to be doing in each step we take.”

iii) Present the Lego to the children

“Who knows what we are going to do today? Yes, we are going to build the ______”. Get a discussion going together with the children on how to go about building the item.

“So, what is it that we have to do to build the ______? What do we need?” (Elicit the instructions). “Then what else?” (Take turns to build).
iv) **Demonstrate the self-talk**

“Ok… look…first step. This piece maybe… maybe not… easy…”

v) **Provide appropriate scaffolding**

Scaffold and ensure that children use self-talk during the building of the Lego, particularly when they find it challenging. After the building has been completed, reinforce the self-talk and the attention of the children. Allow a few minutes for the children to play with the Lego before summarizing the session.

vi) **Summarize the session**

Summarize the session by telling the children to remember to self-talk using the three steps we have learnt. Look and listen as well as keep on track and always ask themselves what they are doing.

Provide examples on how they can use self-talk at home and school. “At home when you are packing your bag for school the next day, you can use self-talk to plan and make sure you know what you have to do and pack all your things.”

Figure 6: The objective of this 3rd week is to be able to plan.
Week 4

Sessions 7 and 8: Step by step… but what if I get stuck?
Week 4

Sessions 7 and 8: Step by step… but what if I get stuck?

These sessions are a continuation of the previous week. The focus of these sessions is still to use self-talk during planning. This week, the tasks chosen are designed to be challenging for children to elicit higher amounts of self-talk, and to provide opportunities to scaffold and encourage them to use self-talk to problem solve when they are faced with challenges. The objective of this week is for them to be able identify the challenge, use their self-talk to describe the challenge, and to talk themselves through the challenge with scaffolding by the therapist. The therapist will ask leading questions and talk through the problem with the children.

Encourage the children to look back (to trace their previous steps) and also to look at the future steps to get the bigger picture. When they encounter challenges, the therapist and child will work through the challenges together.

A key focus with children with SLI is to encourage them to be able to ask for help when they are faced with challenges instead of dwelling on the problem silently and eventually getting distracted and giving up.

Objective of the sessions

These sessions focus on using self-talk for planning and problem solving and also on identifying challenges and asking for assistance if help is needed. To achieve this objective, the therapist should:

- Encourage more self-talk as tasks get more challenging.
- Continue to verbally scaffold during planning and problem solving.
• Allow the children to build independently when they are able to and use conversational prompts and leading questions when they have difficulties.
• Ensure they use self-talk when they need to pay attention, sustain and re-focus attention.

**Session 7, 8 and 9**

**Suggested items:**

5-7 year old: 5932 Helicopter, 6166 Helicopter, 5932 Whole set, 4628 Ship, 4635 Racing car and/or Green car.

4 year old: 6138 Fire Station, 10525 the zoo animals or farm animals, 4628 Blue shark, Horse and Girl, 5932 Car, 4628 House.

**Sessions 7, 8 and 9 Structure**

i) **Recap session 6 about using self-talk during planning**

“Who remembers what we have learnt so far?” (Elicit answers from children and reward correct answers with stickers and praise). “Yes, the three steps are: look and listen, pay attention, second is to keep on track, and third is to plan what to do.”

Explain briefly what they mean. “Look and listen means we have to self-talk to tell ourselves to look at our work and listen to instructions so we know what to do. Keep on track means we keep on going with our work until we finish it. Plan means to tell ourselves what to do and the steps to take”. (If children appear lost or confused, spend some time explaining and recalling the previous sessions).

ii) **Introduce today’s task: Lego building gets more challenging**

“Today we are still going to plan with our Lego, but this week, I have brought new Lego that may be harder than before. Who remembers, what is a plan?” (Elicit answers from children). “Yes, when we are going to build something, or do a project, we need to know what we have to do first. This is called a ‘plan’.”
“So when we do our work, we need to self-talk to tell ourselves what we are supposed to be doing so we can keep on doing it until we finish.”

“When the building gets hard, we need to try to solve the problem. We can also solve it together and you can ask for my help as well.”

“When we forget, or get distracted, we can always use self-talk and ask ourselves: What am I doing? What to do now? Oh, I am doing the ___, and keep on doing it. So remember to tell yourself what you are supposed to be doing in each step we take.”

iii) **Encourage the use of self-talk**

“Ok let’s see what we have here. Who knows what we are going to do today? Yes, we are going to build the ______”. Get a discussion going together with the children on how we can go about building the item.

“So, what is it that we have to do to build the ______? What do we need?” (Elicit the need to get the Lego instructions). “Then what else?” (Get the children to discuss the pieces that they need and to plan how to go about building the object.)

iv) **Sensitively scaffold and use leading questions and prompts when they get stuck**

Demonstrate the use of self-talk when building with the children. “This look tricky, maybe I need to look at the picture another way. Hmm, this here… I need a blue…. This is hard… oh, wrong I think”

Ask leading questions such as, “What is next? What is the next step?”

v) **Encourage the children to initiate asking for assistance**

Ask children if they require assistance. “Are you stuck? What do you do when you are stuck?” “You can ask for help”.

vi) **Reinforce self-talk and emphasize self-praise when they achieve task completion or overcome a challenge**

It is vital to encourage children to notice their accomplishments and teach them to praise themselves. “Well done. You had a great plan. You can also tell yourself that”. Demonstrate self-praise, “Yay! I did it”.

vii) **Provide appropriate scaffolding**
Scaffold and ensure that children use self-talk during the building of the Lego particularly when they find it challenging. After the building has been completed, reinforce the self-talk and the attention of the children. Allow a few minutes for the children to play with the Lego before summarizing the session.

viii) **Summarize the session**

End the session by talking about problems the children encountered when planning. Talk about steps they can take to solve the problem such as going back a few steps, looking at the next steps and also asking for help. Talk about the situation in the classroom and at home and discuss with the children who they can ask for help. Reinforce all the steps that they have learnt using their hands as a visual cue.

![Figure 7: The visual cue of the hand and the fourth step in T2T](image)

**Note:** The therapist is encouraged to take individual photos of the children at the end of session 8 to be used in the craft activity in session 10.
Week 5:

Session 9: Step by step… but what if I get stuck?

Session 10: Remember, Talk to Think!
Week 5

Session 9: Step by step… but what if I get stuck?
Note: This session’s objectives and outline are the same as for sessions 7 and 8 from Week 4 (page 126).

Session 10: Remember, Talk to Think!

This session’s focus is to summarize the self-talk training. Children are encouraged to discuss and talk about self-talk and what they liked about the sessions. The therapist reiterates the importance of self-talk in everyday life both in school and at home. The therapist provides examples of how they have used self-talk during the sessions and in class.

Objectives of the session

The objective of this session is to reinforce all the previous objectives and what has been learnt throughout the T2T programme. To achieve this objective, it is important that during this session, the therapist:

• Recaps self-talk training and what they have learnt
• Clarifies any confusion or misunderstanding
• Explains how to use self-talk in the classroom and at home
• Makes a craft activity (photo frame) that reminds the children of the steps learnt during self-talk training to display in class and at home as a visual reminder to use self-talk.
**Suggested items:**

All age groups: Each child’s photo (the therapist can take photos of the children the previous week and print them for this week. This ensures that all children have the same size image to be used). Craft items: manila card, coloured paper, paint, coloured pencils, crayons, markers, craft embellishments and stickers, glue, string, scissors.

![Sample photo frame](image)

**Figure 8:** Sample of a photo frame for young children

**Session 10 Structure**

i) Summarize the T2T self-talk training programme.

“Today is our last time together. Who can tell me, what are the five things we have learnt about using self-talk? (Put up your hand to provide a visual cue). “Yes that is right, we can use self-talk to look and listen to pay attention, second to keep on track, third to plan what to do, fourth to know what steps and fifth, to ask for help.” (Reward correct answers).

“Who can tell me why is it important to use self-talk?” (Elicit answers from children).
Get a discussion going about when and how to use self-talk in class and at home. “Today, we are going to try to remember all these steps so that you can still use self-talk even if you don’t see me anymore”.

ii) **Introduce craft activity**

“Remember I took photos of all of you last week? I have printed them, look at these.” (Show children their photos). “Today we will be doing a craft project. We will make a photo frame with all these things here. These photo frames are special because it also has our hand print with all the things we need to remember about self-talk.”

In this session, after the summary and sharing session, the children make a photo frame with their picture, hand stamp and the five things to remember for using self-talk: pay attention, sustain attention, plan, problem solve, ask for help. Older children can write the 5 things to remember as shown on Figure 9, however, for younger children, who have not learnt to read or write, simple images such as those shown in Figure 8 can be used to remind them of the 5 things to remember. The images used have to be explained to the children and their teachers beforehand to ensure that they remember what each picture stands for. They make their own frame and decorate it with the materials provided. Children are encouraged to remember the use of self-talk by looking at the picture. The framed picture can be displayed in their classroom for several weeks before they take it home.

iii) **Thank children for their participation.**

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**Figure 9: Remember the 5 steps of T2T!**

- Look and listen
- Keep on track
- Let’s plan
- Steps to take
- Ask for help if I am stuck
References


Appendix A
The 5 components of Self-Talk Training:

1. **Look, Listen**: Getting children to pay attention to the activity at hand. Help children use words they understand and can say to themselves to help them control their focus. (e.g. “Let’s look at this book”. “Listen to the instructions of the game”. “See this carefully” “Big eyes look, Listening ears”).

2. **Keep on track**: Getting children to stay focus on the activity and minimizing distractions. Teach them to shift their attention back to the activity after an external distraction (loud noise, dog barking, siblings) and also distractions from themselves (talking about other unrelated things, doing unrelated activity). This helps them to stay on to complete the activity (e.g., “I’ve got to keep doing it till I finish”; “ok, it was just the dog barking, now I’ve got to go on”; “Just keep going”).

3. **Let’s plan**: Getting children to know what they are supposed to do clear. We want them to be able to know what the end goal is and what the early steps to take are (e.g., “We are making a cake. We need to get a bowl first, and all the things to mix. What is the plan?”).

4. **Steps to take**: Break the activity into smaller steps that are manageable for your children. Do the activity step by step. Guide them to talk through the steps to take, so they know what comes next and they are able to tell themselves what to do (e.g., “We need to get things for the cake. First is butter and sugar. We need to measure it. We’ve got to get the measuring cups out. Then, we need to put them in the bowl...”). Ensure that the child clearly knows what comes next.

5. **Ask for help**: To be successful in doing an activity, it is important that children are able to ask for help when they get stuck and do not know what to do. Encourage them to seek help when they need to.
While using the 5 steps of Self-Talk training remember to use these:

1. Questions to the self. (e.g.: What should I do? Who do I ask for help?)

2. Plans for action (e.g.: I need to pack my bag before I go to bed, so I won’t be late tomorrow)

3. Self-Corrections. (e.g.: Oops! I made a mistake here. It’s ok, I have to erase and start over)

4. Self-Praise: (e.g.: Wow! I did a super job in reading today!)
Chapter 4

Effectiveness of Self-talk Training for Planning and Problem Solving in Children with Specific Language Impairment

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A shortened version of this paper is currently under review at the Journal of Abnormal Child Psychology.
Effectiveness of Self-talk Training for Planning and Problem Solving in Children with Specific Language Impairment

Abstract

Self-talk has been shown to be important for the planning and problem solving of children. Our wait-list intervention study examined the effectiveness of a self-talk training programme for improving self-talk, and consequently, the planning and problem solving performance of 87 children aged 4-7 years with Specific Language Impairment (SLI) who were delayed in their self-talk development. The self-talk and Tower of London (TOL) performance of children with SLI (n=47 in Training Group 1 and n=40 in Training Group 2) was compared with that of 80 typically developing children who did not receive any intervention. Children were tested at three time points: Time 1 - prior to intervention; Time 2 - after the first SLI group had received training and the second SLI group provided a wait-list control; and Time 3 - when the second SLI group had received training. At Time 1 children with SLI produced less self-talk and were impaired on the TOL relative to the typically developing children. At Time 2, the TOL performance of children with SLI in the Training Group 1 improved significantly, whereas there was no improvement for Training Group 2 (the wait-list group). At Time 3, Training Group 2 improved their TOL performance and the Training Group 1 maintained their performance. No significant differences in TOL performance were evident between typically developing children and those with SLI at Time 3. This showed that self-talk training was effective in increasing self-talk and in improving planning and problem solving performance in children with SLI.

Keywords: Self-talk, SLI, Children, Executive Function, Planning and Problem Solving
One of Vygotsky’s most significant contributions in the area of children’s cognitive development is his observation that children use language not only for interpersonal communication but for intrapersonal use. Vygotsky noted that children use language for self-regulation and cognitive processing. He termed this intrapersonal use of language for children’s own individual benefit ‘speech for self’, more commonly known in recent years as self-talk or private speech (Vygotsky, 1987; Winsler, 2009). Research on self-talk has confirmed Vygotsky’s theory that verbal mediation is vital for a number of cognitive and executive processes including planning and problem solving in children as young as 3 years of age (Winsler, 2009). Delays in self-talk have been linked to deficits in planning and problem solving (Behrend, et al., 1992; Fernyhough & Fradley, 2005). Indeed, one population that is known to experience delays in both self-talk and planning and problem solving is children with specific language impairment (SLI) (Bishop, 1992; Lidstone, et al., 2012; Sturn & Johnston, 1999). Because of this, children with SLI may benefit from self-talk training programmes, and in doing so, provide the ideal opportunity to examine the purported causal link between self-talk and planning. However, no study to date has attempted to implement a self-talk intervention to assist children with SLI to improve their self-talk. Therefore, the aim of this study was to first examine the effectiveness of a self-talk training programme designed to increase self-talk in children with SLI, and to subsequently examine whether any changes in children’s self-talk are associated with improvements in their planning and problem solving.

While Piaget viewed self-talk as a form of egocentric and immature communication development among preschool children, Vygotsky contended that self-talk is an essential tool for cognitive self-guidance that emerges when children are 4-6 years old (Piaget, 1977; Vygotsky, 1987). Vygotsky theorized that self-talk stems from social interactions with significant others in the child’s life. Through these interactions and the direct verbal
regulation of significant others, children learn to use verbal regulation for themselves. In the beginning, children’s self-talk is overt and can be either social or private in nature. As children age, this overt self-talk becomes internalized to form inner speech and silent verbal thought (Moll, 1992; Vygotsky, 1987).

Studies have shown that language and executive functioning, particularly, planning and problem solving, are intrinsically linked (Marton, 2008; Müller, et al., 2004; Zelazo, et al., 2003). Planning and problem solving involve the ability to formulate, select, and evaluate a sequence of thoughts and actions to achieve a desired goal (D’Zurilla & Goldfried, 1971; Stuss, 1992). Children need sound planning and problem solving skills to meet their daily personal, social and educational demands such as organizing themselves and planning their work, developing and keeping friendships, handling social interactions with significant others, pursuing academic tasks such as writing essays, solving mathematical problems, as well as organizing and completing school projects (Ellis & Siegler, 1997; Sandberg & Huttenlocher, 2001). Self-talk is important because it helps children regulate their own behaviour and cognitive processes in order to plan and problem solve (Luria, 1976). Zelazo’s (2003) Cognitive Complexity and Control theory states that self-talk is important for executive functioning as it allows the child to be more aware of their activity so that they can link current conditions to their consequences and be in a better position to plan and problem solve.

Experimental evidence has further confirmed the importance of using language for planning and problem solving. For example, several studies that prevented self-talk by asking participants to engage in the rehearsal of a single word repeatedly (e.g., Sunday, Sunday, Sunday) while performing a task, have shown this to have a negative impact on performance on a number of planning and problem solving tasks including the Wisconsin Card Sorting (Baldo, et al., 2005), Raven’s Progressive Matrices (Kim, 2002) and the Tower of London.
(Lidstone, et al., 2010; Wallace, et al., 2009). In contrast, planning and problem solving has been shown to be unaffected by concurrent tasks that do not involve language (e.g., foot tapping). This suggests a close and potentially causal link between self-talk and planning and problem solving performance (Lidstone, et al., 2010).

Perhaps unsurprisingly then, many researchers have attempted to improve the self-talk of children known to have delays in planning and problem solving, such as children at risk of impulsive/hyperactive or inattentive behaviours. This has been done either through self-talk training or explicit instructions to children to use self-talk. Self-talk training such as the Self-Instructional Training (Meichenbaum & Goodman, 1971) and Think Aloud (Harris, 1990) programmes have targeted children with ADHD or those with impulsivity and externalizing behaviour problems because of the difficulties these children experience with behaviour regulation. Strongly grounded in the cognitive behaviour model, particularly with regards to modelling and fading techniques, these self-instructional training programmes typically involve an adult providing a script and demonstrating appropriate self-talk. The child is then expected to follow the same script first overtly while doing the task, and then covertly by repeating the same script using lip movements without overt speech and then again without lip movements. Although these self-instructional programmes initially seemed promising in terms of improving performance on cognitive tasks (Kendall & Finch, 1978; Meichenbaum & Goodman, 1971), a meta-review of 13 previous reviews on the efficacy of self-instructional training concluded that these training programmes were ineffective as stand-alone interventions to improve behaviour regulation in children with ADHD due to unfounded assumptions regarding the nature of self-talk in these children (Diaz & Berk, 1995). First, it was assumed that children with ADHD are delayed in their self-talk and do not use much self-talk compared to their typically developing peers. Second, these programmes assumed that modelling long and rigid scripts of instructions and expecting children to imitate what to
say would be effective for self-regulation. Recent research has shown these assumptions to be incorrect. In particular, children with ADHD have been shown to use the same amount of self-talk as typically developing children but a greater proportion of overt self-talk (Winsler, Manfra, et al., 2007). Providing long rigid scripts, which turns self-talk into a broadcast of thoughts, has also been shown to be unhelpful and to some extent counter-productive to planning and problem solving as it limits the children’s ability to use their own self-talk. In contrast, self-talk training that builds on children’s existing self-talk has been found to be effective in assisting children to use their self-talk (Diaz, et al., 1992).

Diaz et al. (1992) carried out a small but successful study using self-talk training with young children at risk of hyperactivity and impulsivity. Instead of providing rigid scripts, they used Vygotskian principles of sensitive scaffolding: asking leading questions, verbally guiding the children’s behaviour when they encounter challenges, and reducing adult scaffolding when children are able to use their own self-talk independently while successfully performing the task. The results showed that the children improved in terms of their performance on a planning and problem solving task, were more mature in their use of self-talk, and teachers noted reductions in their impulsive behaviours in the classroom. In another study, Winsler, Diaz and Montero (1997a) examined the self-talk of a group of children while they were completing a problem solving task with and without adult verbal scaffolding. They found that children were more likely to use self-talk and to succeed on a task using self-talk after receiving verbal scaffolding from an adult compared to children who did not receive verbal scaffolding. Other studies have also shown that adult scaffolding and teaching in joint activities improves children’s subsequent private speech and is associated with better behaviour and planning performance (Berk & Spuhl, 1995; Diamond & Lee, 2011). More recently, another self-talk training programme, the Tools of the Mind curriculum, has been developed based on Vygotskian principles. This programme is a play-based curriculum with
a focus on literacy and mathematics and has been used widely in preschools in the United States. Results of a randomized control trial comparing the Tools of the Mind programme with regular classroom instruction suggests that it is effective in improving the executive functioning, social and academic success of young children (Diamond & Lee, 2011).

These studies suggest that certain types of self-talk training may be more effective than others. Successful self-talk training programmes have been based on Vygotskian theoretical principles such as: involving children as active learners, using play-based activities to develop language, using verbal prompts and leading questions during planning and problem solving, selecting tasks within the zone of proximal development that are optimal for learning, and sensitive adult scaffolding during social interactions (Diaz & Berk, 1995; Moll, 1992; Vygotsky, 1987). The successful self-talk training interventions by Diaz et al. (1992) and Winsler et al. (1997) have also followed the Vygotskian tenets of successful verbal scaffolding. First, self-talk will emerge spontaneously in response to item difficulty, at which point the adult should scaffold and demonstrate self-talk to plan and problem solve the next step. More verbal guidance is offered when children find the task challenging and less guidance when they are successful. Second, self-talk should be used to sustain attention when concentration levels drop. This is particularly a focus for children who have problems with impulsivity, inattention or hyperactivity. Third, children should be taught self-talk strategies, rather than providing explicit scripts, to encourage them to use their own planning speech across other activities, and lastly, children should be encouraged to use self-talk for self-regulation to remember the tasks and goals when there are distractors present. This is particularly important in a school setting where there are many external distractions.

Given the evidence that self-talk training can be successful in improving the self-talk and subsequent planning and problem solving performance of both typically developing children and children who have externalizing and impulsive behaviour problems, the question
arises as to whether this training can be used to improve verbal mediation in children with language impairments. Specific Language Impairment (SLI) is characterized by impairments in receptive and/or expressive language that are not the result of neurological, intellectual, sensory or emotional deficits. It affects approximately 7% of young children aged 4-7 years. Therefore, children with SLI may have expressive language difficulties that limit their verbalization and use of self-talk and/or receptive language deficits that impair their comprehension during interactions with significant others, including their comprehension of any verbal scaffolding provided to them. As a result, some children with SLI may face a double barrier in terms of self-talk development.

Indeed, there is recent evidence has suggested that children with SLI are delayed in their self-talk and planning and problem solving performance compared to children whose language development is age appropriate (Abdul Aziz, et al., under review; Lidstone, et al., 2012; Sturn & Johnston, 1999). Sturn and Johnston (1999) recorded pre-schoolers’ overt social and private self-talk during a construction task. They grouped SLI and age- and language-level matched peers together in dyads to complete the task. The researchers noted that children with SLI talked less overall compared to typically developing children and also produced less problem solving speech. They also performed worse on the construction task compared to their matched peers. Sturn and Johnston (1999) showed that in typically developing children, those who had more problem solving speech were better at the construction task, however in children with SLI, the opposite was found; those who had more speech in the SLI group performed more poorly in the construction task. The authors concluded that children with SLI are less likely than their age matched peers to use language for cognitive purposes. However, as the authors indicate, the small numbers (N=6) in each of their groups limited their ability to draw strong conclusions.
In a more recent study, Lidstone et al. (2012) assessed SLI and age and non-verbal IQ matched children aged 7-12 years using the Tower of London (TOL) task to observe the role of self-talk during planning and problem solving. Both SLI and their typically developing peers completed the TOL tasks under three conditions: a baseline (no dual task) condition that was performed first, and two dual task conditions (articulatory suppression and foot tapping). In the baseline condition, Lidstone et al. (2012) found that Children with SLI performed more poorly than controls on the TOL, indicating poorer planning and problem solving performance in the SLI group. Children with SLI also had more overt self-talk and less internalized speech than their typically developing peers. Given that this research was conducted with children in middle childhood, the overt and less internalized self-talk of children with SLI indicates a delayed pattern of self-talk development in children with SLI.

In the dual-task conditions, the authors found that compared to foot tapping, articulatory suppression impaired TOL performance in both groups, and concluded that both typically developing and children with SLI use self-talk to support planning performance. However, closer examination of performance on the baseline and articulatory suppression conditions revealed no difference in performance for the SLI group whereas the typically developing group performed more poorly on the TOL with articulatory suppression. This suggests that self-talk may be more affected by articulatory suppression for the typically developing children compared to children with SLI.

Further evidence for a delay in self-talk in children with SLI comes from a recent study by Abdul Aziz, Fletcher and Bayliss (under review), in which they examined the self-talk of 91 children with SLI and 81 of their typically developing peers (aged 4-7 years) during completion of the TOL task. To examine whether self-talk in the SLI group was in fact delayed or deviant, Abdul Aziz et al. (under review) examined the self-talk of both groups across three grade levels (Kindergarten, Preprimary and Year 1). Consistent with previous
studies, the results showed that children with SLI were impaired on the TOL relative to their typically developing peers, but also revealed that this deficit is evident from a very early age (i.e., first year of schooling). In terms of self-talk, children with SLI were found to use self-talk for planning and problem solving, but they produced less self-talk overall than typically developing children, particularly in Kindergarten. Abdul Aziz et al. (under review) also found that typically developing children produced significantly more inaudible muttering than children with SLI who had almost no inaudible muttering, pointing towards a delay in the internalization of self-talk. Taken in combination, these results point towards a delay in self-talk development in children with SLI.

The present study

Given the evidence that children with SLI are delayed in their self-talk and are known to have problems with planning and problem solving, which may impact on their functioning in other areas, improving their ability to use self-talk could have wide ranging implications for these children. In addition, examining the impact of a carefully scaffolded self-talk training on planning and problem solving performance will have implications for our understanding of the link between self-talk and planning and problem solving, and by extension, executive functioning. Finally, given the high proportion of hyperactive and inattentive behaviours in children with SLI (Cohen, et al., 2000), and the potential of self-talk to help with self-regulation of behaviour (Diaz et al. 1992), a self-talk training intervention may be useful in reducing these hyperactive and inattentive behaviours in children. Despite these obvious and potentially important benefits, to the best of our knowledge, there have been no studies investigating the effectiveness of a self-talk training programme within the SLI population.

To address these important issues, this study was designed to implement and evaluate a self-talk training intervention with children with SLI. We developed a play-based self-talk training programme using the main themes of Miechenbaum’s self-instructional training and
the Vygotskian principles of verbal scaffolding which aims to build on the children’s own self-talk rather than providing a script. The first aim of this study was to evaluate the effectiveness of the self-talk training programme by examining both the amount and the nature of the self-talk of children with SLI before and after training. The second aim of this study was to examine whether self-talk training led to any improvements in planning and problem solving for these children, as measured by performance on the TOL. Given that Abdul Aziz et al. (under review) showed that a deficit in planning performance was already evident in the first year of school, we implemented the training programme with young children with SLI (aged 4-7 years) across three year groups (Kindergarten, Preprimary and Year 1). This allowed us to look at age-related changes and any potential shifts in the different types of self-talk (social speech, private speech and inaudible muttering) across the three grade levels. In addition, given Diaz et al.’s (1992) finding that self-talk training improved the attention and impulsive and hyperactive behaviours of young children at risk of impulsivity and hyperactivity, we wanted to see if this would be the case for children with SLI as well. Therefore, the third aim of this study was to examine whether self-talk training led to any changes in hyperactive and inattentive behaviours in children with SLI.

Method

Participants

One hundred and seventy eight children between 4 and 7 years of age (age range: 48 - 80 months) were recruited from Language Development Centres (LDCs) and primary schools in Perth, Western Australia. The children were in Kindergarten, Pre-primary or Year 1 at the time of recruitment, and are the same children that participated in Study 1.
LDCs are schools for early learning for children who have been diagnosed with SLI. Children eligible to attend LDCs have been assessed by relevant professionals, using standardized tests and clinical judgment, to have significantly impaired language development together with at least average nonverbal intelligence and adequate adaptive behaviours. LDCs are located throughout greater metropolitan Perth, as a subsection of a bigger primary school. Children with SLI typically attend the LDC from Kindergarten to Year 1 before exiting to mainstream primary school in Year 2. In the current study, 94 children with SLI were recruited from LDCs in five different suburban areas. Eighty four typically developing (TD) children were recruited from the same school area as the children with SLI to ensure the groups were equivalent in terms of socioeconomic background. All children included in the study were required to have average to high average nonverbal intellectual ability. This was operationalized as scores of 85-125 on the Wechsler Non-Verbal Scale of Ability (WNV). All children were also required to pass the practice items on the TOL. Children with SLI were also required to score below average on the general communication composite (GCC) of the Children’s Communication Checklist – Second Edition (CCC-2), while the TD children were required to have at least average scores on this test. Seven children were excluded from the study: four children with SLI (two for having lower than average nonverbal IQ and two for not being able to complete the TOL practice trials); and three TD children (two because their nonverbal IQ scores were >125, and one due to technical difficulties with the video camera). Descriptive data are provided in Table 1.
Table 1

Means and Standard Deviations for Age, Non-Verbal IQ and General Language in TD and Children with SLI at Time 1 (pre-intervention)

<table>
<thead>
<tr>
<th>Group</th>
<th>n</th>
<th>Age in months (SD)</th>
<th>WNV scores (SD)</th>
<th>GCC scores (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SLI</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>62</td>
<td>63.78 (9.87)</td>
<td>103.52 (10.99)</td>
<td>47.25 (12.38)</td>
</tr>
<tr>
<td>Female</td>
<td>28</td>
<td>61.04 (8.62)</td>
<td>103.41 (11.05)</td>
<td>49.28 (10.64)</td>
</tr>
<tr>
<td>K</td>
<td>35</td>
<td>52.85 (2.72)</td>
<td>104.91 (10.88)</td>
<td>51.65 (10.29)</td>
</tr>
<tr>
<td>PP</td>
<td>24</td>
<td>63.96 (3.42)</td>
<td>104.56 (11.06)</td>
<td>47.18 (12.33)</td>
</tr>
<tr>
<td>Y1</td>
<td>31</td>
<td>73.57 (3.92)</td>
<td>101.03 (10.86)</td>
<td>44.25 (12.21)</td>
</tr>
<tr>
<td>TD</td>
<td>81</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>48</td>
<td>66.00 (9.94)</td>
<td>108.26 (9.24)</td>
<td>78.17 (14.77)</td>
</tr>
<tr>
<td>Female</td>
<td>33</td>
<td>65.88 (10.80)</td>
<td>108.88 (9.55)</td>
<td>77.62 (14.47)</td>
</tr>
<tr>
<td>K</td>
<td>25</td>
<td>53.44 (4.01)</td>
<td>107.68 (9.12)</td>
<td>78.76 (12.92)</td>
</tr>
<tr>
<td>PP</td>
<td>24</td>
<td>65.67 (4.09)</td>
<td>110.62 (8.92)</td>
<td>80.96 (14.79)</td>
</tr>
<tr>
<td>Y1</td>
<td>32</td>
<td>76.26 (3.24)</td>
<td>107.58 (9.81)</td>
<td>74.94 (15.47)</td>
</tr>
</tbody>
</table>

Note: SD = Standard Deviation, K = Kindergarten, PP = Preprimary, Y1 = Year 1, GCC: General Communications Composite of the CCC-2.

Tasks and Procedures

Nonverbal ability. The two screening subtests of the Wechsler Non-Verbal Scale of Ability (WNV; Wechsler and Naglieri, 2006), Matrices and Recognition, were used as a measure of nonverbal ability as these subtests were not part of the psychometric testing
previously carried out on children at the LDCs. The nonverbal full scale score calculated from the scaled scores on the two subtests provides a measure of nonverbal IQ. The reliability of the WNV for this age group is between .88 and .91. The correlation between the WNV and the WPPSI-III for the full scale score based on these two subtests is .67 (Naglieri & Brunnert, 2009).

**Language ability.** The Children’s Communication Checklist-second edition (CCC-2; Bishop, 2003) was completed by parents of all participating children. The CCC-2 is a screening tool that identifies children with pragmatic language impairment and SLI. This was done to ensure average communication ability in the typically developing group and to confirm below average communication ability in the SLI group. The reliability of the CCC-2 ranges from .86 to .96 for this age group. The CCC-2 was scored using the computerized scoring procedure provided by the test publishers. The criteria for below average communication ability were a cut-off score of below 55 on the GCC or scores below the 10th percentile on three subscales (Bishop, 2003), which is indicative of SLI. None of the TD children in this study met the CCC-2 criteria for SLI, while all of the children with SLI did.

**Behaviour rating.** The Strengths and Difficulties Questionnaire (SDQ; Goodman 2001) is a brief behavioural screening questionnaire consisting of 25 items with 5 subscales: emotional distress, behavioural difficulties, hyperactivity/inattention, peer relationship problems and prosocial behaviours. The SDQ has moderate to strong reliability across all its subscales and sound external validity (Hawes & Dadds, 2004) with a correlation of .87 with the Child Behaviour Checklist (CBCL) (Goodman & Scott, 1999). The SDQ was scored and converted to standard scores based on Australian norms by Mellor (2004). The Hyperactivity/Inattention subscale was used to identify children with elevated levels of hyperactive and inattentive behaviours. Scores ranging from 7-10 on the Hyperactivity subscale of the SDQ indicates a ‘high substantial risk of clinically significant problems in this
area’ (Goodman & Scott, 1999). Children with scores in this range were categorized as having hyperactive and inattentive behaviours. However, it is important to note that, being a screening tool, this does not amount to a diagnosis of ADHD.

**Planning and problem solving task.** The Tower of London task (TOL; Shallice (1982) was used as a measure of planning and problem solving performance. As noted previously, the TOL has been widely used in self-regulation and executive functioning research in children (Berg & Byrd, 2002; Berg, et al., 2010; Shriberg, et al., 1999), and has been shown to require planning for successful performance (Lidstone, et al., 2010, 2012; Phillips, et al., 2001; Williams & Jarrold, 2010). The TOL is available in both mechanical and computerized forms. The mechanical version of the TOL was used in this study for a number of important reasons. The use of this version enabled a comparison with previous research examining planning in Children with SLI, which has typically used the mechanical TOL. Second, the mechanical version of the TOL is appealing to young children due to its novelty and game-like appearance, and is often described to children as a ‘ball puzzle game’. Planning tasks such as the TOL have also been shown to elicit a high amount of self-talk. Another reason for the selection of the mechanical version was that young children may not have had much exposure to a computer and computer games. Having an examiner face to face with the young child also helps to engage and sustain their attention throughout the session. The mechanical version of the TOL consists of two identical wooden game boards, one for the child and one for the examiner. The game boards were made up of three descending pegs: tall, medium and short, which held three, two or a single ball of the same-size respectively. There were three different coloured balls: yellow, blue and red, for each game board. The children were instructed to move the balls on the pegs of their board to match the ball arrangement on examiner’s board in the minimum number of moves.
In the present study, there were 4 practice items and 17 structurally unique TOL test problems ascending in difficulty from problems that could be solved in a minimum of 3 moves up to problems that required a minimum of 7 moves. This series was obtained from a computerized TOL version developed by W. Keith Berg and colleagues (Berg & Byrd, 2002; Berg, et al., 2010). Administration of the TOL followed the procedures used in a previous study by MacDonald and Berg (2005). The child was told that there were three rules to the game: 1) they could only move one ball at a time, 2) the balls needed to be on a stick and not anywhere else, 3) the shortest stick could only hold one ball, the medium stick could hold two balls and the tallest stick could hold three balls. However, instead of asking the child to place one hand behind their back to prevent them from moving two balls at one time, the child was asked to put his/her non-dominant hand in a glove and was instructed not to use the hand in the glove. This served as a visual reminder for young children to only use one hand and to move only one ball at a time. This helped minimize rule violations of moving more than one ball at a time.

The child was given four practice items. Teaching was provided if the child failed the first trial of a practice item. The children were required to pass two or more practice items to proceed to the test items. After the practice items, children were given the test items. Each problem proceeded until either the child completed the problem, gave up, or violated a rule. If a child showed intention of violating a rule but had not moved the ball from the peg (e.g., holding two balls at one time), the child’s movement was stopped, the rules were repeated again, and they were allowed to continue with the task. However, if the child had already violated the rule, such as moving two balls and putting them on another peg, the child’s movement was stopped, the rules were repeated again and the balls were returned to the original start state. A fail was recorded for the trial and the child was given a second trial on the same test item. If the child failed both trials of a given item, they were considered to have
failed the item and were given the next item. Each item began when the examiner presented
the game boards to the child and ended when the child completed the item or when they gave
up after trying. Testing was discontinued when a child failed three consecutive items or
completed the last item.

General Procedure

Informed consent was obtained from school principals and parents prior to testing. All
children were screened with the WNV to ensure average to high average non-verbal ability.
Parents were asked to complete the Children’s Communications Checklist – 2nd edition
(CCC-2) and the SDQ-Parent. Teachers were asked to complete the SDQ-Teacher.

The TOL task was administered individually to each child by an examiner. Two
examiners were involved in testing the children; both were young females with a graduate
degree in psychology. Each child was tested during school hours in a quiet area in the school.
The TOL and SDQ were administered at three times as indicated in Figure 1. Four children
\((n=3\) in the SLI and \(n=1\) in the TD group) withdrew from the study after testing at Time 1
leaving \(n=87\) for children with SLI and \(n=80\) for TD children. The configuration of the TOL
during the three administration times were isoforms of each other; meaning they had the same
level of difficulty but had different configurations (Berg, et al., 2010).

Children were audio and video taped for later scoring of total number of moves made,
total time taken, rule breaks and self-talk using a small, unobtrusive video camera that was
positioned at a 30-degree angle facing the child. The video camera was unobtrusive and
children seemed not to be affected by it. The self-talk data included in the analyses was coded
from the beginning of each test item until the child completed or discontinued the item, for all
items the child attempted.

Scoring of the TOL
The total time, number of moves and total rule violations were recorded for each item. Each item was then given a score out of 3. A score of 3 was given when a child solved the problem during the first trial in the minimum number of moves. A score of 2 was given when a child solved the problem during the first trial but not in the minimum number of moves. A score of 1 was given when a child solved the problem during the second trial of an item. A score of 0 was given when the child failed both trials of an item. A total score was derived by summing the scores across the completed items.

**Coding of Speech**

All speech recorded during the TOL administration was coded in terms of utterances. An utterance was defined as a sequence of spoken words with less than a 2 second gap between words. Mean utterances per item was calculated by dividing the total number of utterances by the number of TOL items attempted (MacDonald & Berg, 2005). The children’s utterances were coded for addressee (private or social speech), task relevance (planning or non-planning speech) and inaudible muttering.

**Addressee:** As the children were young, we followed Sturn and Johnston’s (1999) method of coding both private and social speech. All utterances were considered social speech when there was child-examiner interaction. This was defined as speech that was accompanied by any one or a combination of these features:

- Eye contact or eye gaze
- Using the examiner’s name
- Asking a question and waiting for an answer from the examiner or
- Initiating physical proximity such as touching the examiner’s hand or leaning towards the examiner.

An utterance was coded as private speech if there was no evidence of social intent.
Task relevance/irrelevance: All utterances that were directly related to solving the TOL were coded as task relevant utterances. These utterances could be used for formulating a plan, focusing and sustaining attention, evaluation or seeking assistance. Examples of task relevant utterances are: “red here... that goes here, maybe not this one”, “I got solve this”, “I want help”, “that was too hard”, “super easy!” Utterances were coded as task irrelevant if they did not relate to the TOL such as remarks about the glove (e.g., “Cool glove”), descriptions of other activities (e.g., “I had a cake for morning tea”), or any other statements about other events or people outside the TOL administration. Task irrelevant speech were not analysed due to the low number of these utterances (2.5%).

Inaudible muttering: This was coded as a separate entity to private speech. inaudible muttering is operationally defined as any whispering, unintelligible muttering or barely audible lip movements or silent lip movements that cannot be heard to be coded into one of the categories described above.

Inter-rater reliability

A graduate student rater, trained with the coding criteria by the first author, independently coded a random 25% of the video and audio recordings for task relevance and addressee – private speech, social speech or inaudible muttering. In addition, each instance of task relevant private and social speech was further coded in terms of four content categories consisting of formulating a plan, focusing and sustaining attention, evaluation, and seeking assistance. Thus, there were nine different speech categories (including inaudible muttering). The total number of utterances classified into each category for each child was calculated for both raters. Inter-rater reliability was then calculated for each speech category by correlating the total number of utterances identified for each child across the two raters. These ranged from $r = .761-.998$. An overall inter-rater reliability was calculated by averaging the
correlations across the nine speech categories. The average inter-rater reliability for self-talk coding was $r = 0.915$.

**Intervention Programme: Self-talk Training**

**General Procedure**

Children with SLI were divided into two groups: Training Group 1, which received self-talk training between Time 1 and Time 2 and no further training between Time 2 and Time 3 (N=47; 9 Kindergarten, 17 Preprimary, 21 Year 1), and Training Group 2 (N=40; 25 Kindergarten, 6 Preprimary, 9 Year 1), which did not receive any self-talk training between Time 1 and Time 2 and received self-talk training between Time 2 and Time 3. The typically developing children were the control group (N=80; 25 Kindergarten, 24 Preprimary, 31 Year 1) and did not receive any self-talk training at any time. It is noted that Training Groups 1 and 2 were not randomly allocated and the number of participants was unequally distributed across the grade levels. The reason for this was purely pragmatic. In three of the LDCs, the teachers of the kindergarten children with SLI preferred the children to be involved in the programme after the first half of their schooling year, citing adjustment to the new school environment and routines during the earlier months. Therefore, there were more Year 1 and Preprimary children in Training Group 1 and more Kindergarten children in Training Group 2. Figure 1 shows the flow of participants and testing times.
Figure 1: Participants flow chart for self-talk training and testing times.
The first author administered the intervention at both time points. Children were divided into groups of three. Each group consisted of children from the same class. A week prior to the start of the self-talk Training programme, each group received a 20-minute warm-up session involving paper folding activities to enable the children to meet the experimenter and become comfortable with her. Each self-talk training group received 10 sessions of intervention over 5 weeks (two 30-minute sessions each week) during school hours in the LDCs.

**Self-talk Training procedure for children**

The objective of the self-talk Training was to improve the Children with SLI’s use of self-talk for planning and problem solving through a collaborative play-based intervention. The self-talk Training was designed to be structured and collaborative, and encouraged verbalization from the children. The self-talk Training utilized Lego building blocks as the main material during planning and problem solving. Lego building was noted to be of high interest in this age group. Building blocks and construction activities have been found to be useful in eliciting planning and problem solving speech (Winsler, 2009). The Lego building task chosen varied according to the children’s age, interest and ability levels. The level of difficulty for Lego building was based on the recommended age of the Lego materials from the Lego education website (www.legoeducation.com). The difficulty level of the Lego building tasks was then increased, based on the children’s performance, to a level where the child found it challenging and needed assistance to complete the building task. This point, referred to by Vygotsky as the zone of proximal development (ZPD) is the point at which most self-talk is expected to be used.

Each session started with the experimenter explaining the objective of the session and giving a recap of the previous session. Issues that may have arisen in the classroom were also addressed. Each session was designed to encourage children to plan overtly. The
experimenter scaffolded the self-talk of children in a dialogic manner, and regulated the collaborative Lego building until the children could take over and solve it. There was no exact script to follow from the adult, rather the children were encouraged to verbalize their plan and the experimenter scaffolded their planning using language that the children understood and could use again (e.g., “Need to make this… like that”, “Hmm, maybe change this piece”). Self-talk and verbalizations were rewarded with stickers to encourage more self-talk. The main Vygotskian principles of scaffolding within the ZPD, to provide encouragement and guidance when the task was challenging and to refocus children’s attention when they were distracted, were adhered to during the self-talk Training.

**Self-talk Training provided to teachers and parents**

There was an emphasis on continued training and monitoring as well as collaborative work between the experimenter, parents and teachers to ensure that the programme was continued and reinforced in the classroom and at home. The class teacher and parents whose children were about to receive self-talk Training were given a DVD illustrating the main principles being taught, as well as hand-outs in printed form about self-talk Training and how to encourage the use of self-talk in the classroom and at home. A week prior to the start of the self-talk Training, the experimenter spent 20 minutes with each class teacher individually to provide an overview of the training. For parents, the experimenter stayed after school in weeks 1, 3 and 5 of the self-talk training to answer any questions about the self-talk Training and sent reminders for them to encourage the use of self-talk at home. On the day of each self-talk Training session, the experimenter met with the class teacher for 15 minutes to go through the session aims and plan for the upcoming session. This equipped the teacher with the necessary information to scaffold and encourage self-talk in their classroom after the self-talk Training session. This regular communication with the class teacher ensured the continued scaffolding of self-talk for children with SLI.
**Intervention programme**

The self-talk Training programme was based on Vygotskian theoretical foundations (Diaz & Berk, 1995; Frauenglass & Diaz, 1985; Frawley & Lantolf, 1986). The five principles of self-talk Training derived from Vygotskian theory are: children are active learners; play is an effective way to develop language; planning and problem solving develop through language; tasks within the ZPD are optimal for learning, and sensitive scaffolding by adults during social interactions assist children in improving their self-talk and planning and problem solving ability (Diaz & Berk, 1995; Moll, 1992; Vygotsky, 1987).

The self-talk Training also incorporated Meichenbaum and Goodman’s Self-Instructional Training main themes of cognitive self-guidance, self-corrections and self-reinforcements (Meichenbaum, 1985; Meichenbaum & Goodman, 1971). There are five components to Self-Instructional Training as designed by Miechenbaum and Goodman: pay attention, inhibit / stop automatic responses to environmental stimuli, regulate behaviour and choose appropriate behaviour to be put in place, use rules and principles to guide behaviour, and maintain a flow of action in working memory(Meichenbaum, 1985; Meichenbaum & Goodman, 1971). These components were incorporated in this self-talk Training programme.

Session 1 and 2: The objective of these sessions was to explain the importance of focusing and paying attention and listening to instructions and other peers who were participating. This was done by encouraging the use of the children’s self-talk for focusing and paying attention to the task at hand. In these sessions, emphasis was given to explaining self-talk and encouraging verbalizations during the sessions. self-talk examples that were used in these sessions were, “Look and listen”, “I need to look for this” and “Blue, blue, where are you?”

Sessions 3 and 4: These sessions incorporated an extra component to focusing and paying attention; namely, to sustain attention and re-focus attention when the child became
distracted by external distractions as well as internal distractions. The sessions focused on making children aware of internal and external distractions and teaching them to use self-talk when they were distracted. For example, children were taught to use their own self-talk such as “Keep on going” to maintain a flow of action, “Look back here” to bring back attention and “I need to finish this” to maintain action.

Sessions 5 and 6: The objective of these sessions was to develop a sequential plan (i.e., a step by step plan in children’s words) with the aim of developing a train of thought about a task. The focus was using self-talk for planning. The experimenter scaffolded self-talk by asking leading questions and using conversational prompts that encouraged planning. The Lego tasks were challenging enough for children that they needed some assistance with building. This encouraged the use of self-talk. These sessions also focused on teaching children to plan ahead and maintain a train of thought to plan their Lego building. Some examples of self-talk used during these sessions were, “I need to make a house”, “Now where does this go”, “Ok, next…this bit” and “Don’t know how”.

Sessions 7, 8 and 9: In these sessions, more challenging Lego building was introduced for planning. The objective of these sessions was to teach children to use their self-talk to recognize the challenges, to be able to use self-talk when they felt challenged, and to be able to ask for help when they got stuck. To achieve this, the children were scaffolded to use self-talk to break down tasks and to go back to a previous successful step and look at the current problem. The experimenter encouraged the children to use self-talk to explain the current challenge, scaffolded their self-talk and worked through the problem with them. Some examples of self-talk used during these sessions were, “This is hard?”, “Hmmm, got to look here”, “Where is the bit?” and “I need some help now”.

Session 10: The focus of this session was to summarize all the skills that the children had learnt and to provide them with a visual reminder of the self-talk Training. In this session
the experimenter spent time talking about the importance of self-talk and how it had helped them. The experimenter also explained how to use self-talk at home and in school. During this session the visual reminder to remember to use self-talk was emphasized and children were encouraged to describe how they could use self-talk at home and in the classroom. The visual reminder uses the child’s hand and the five fingers represent the five main objectives: look and listen, keep on track, let’s plan, step by step, ask for help - one for every week of the self-talk Training.

Results

Data Screening

TOL scores were log transformed to correct for unequal variance across groups. Analyses were then performed on both the raw scores and the transformed scores. The same pattern of results emerged in both analyses, and so, for ease of interpretation, the analysis performed using raw scores is presented. All variables met criteria for normality. An alpha level of .05 was used in all inferential statistics unless otherwise stated.

Group Comparisons on Matching Variables

At Time 1, the typically developing and SLI groups were matched in terms of age, $t(165) = -1.88, p = .062$ Cohen’s $d = -0.29$, but they differed significantly in nonverbal IQ score $t(165) = -3.19, p = .002$, Cohen’s $d = -0.50$. Due to this difference, nonverbal IQ was entered as a covariate in all subsequent analyses involving language group comparisons. The language scores, age and nonverbal IQ are not different between children with hyperactive and inattentive behaviours and those without these behaviours (all $p > .10$).

Effect of Self-talk Training on the Self-talk of Children with SLI

To examine changes in self-talk produced during the TOL before and after self-talk Training for children with SLI relative to their typically developing peers, a 2 (time: Time 1,
mixed factorial ANCOVA was conducted on the Mean Utterance per Item collapsed across all types of self-talk (inaudible muttering, private speech, social speech), with nonverbal IQ scores entered as a covariate. Although there was no significant main effect of time, $F(1,160) = 0.92$, $p = .340$, $\eta_p^2 = 0.01$, there was a significant interaction of time by language group, $F(1,160) = 26.43$, $p < .001$, $\eta_p^2 = 0.14$. Two paired sample $t$-tests performed within the typically developing and SLI group respectively revealed that while the amount of self-talk produced by typically developing children did not change from Time 1 to Time 3, $t(79) = 0.93$, $p = .927$, $d = 0.01$, children with SLI showed a significant increase in self-talk from Time 1 to Time 3, $t(86) = -7.30$, $p < .001$, $d = -0.87$. Thus, children with SLI produced significantly more self-talk during the TOL after the intervention programme (means and 95% CI are presented in Figure 2). Children with SLI had lower amounts of self-talk at Time 1 compared to typically developing children, $t(165) = -2.26$, $p = .025$, $d = -0.35$ and higher amounts of self-talk at Time 3 compared to their typically developing peers, $t(165) = 3.42$, $p = .001$, $d = 0.53$. There was also a significant main effect for grade level, $F(2,160) = 3.79$, $p = .025$, $\eta_p^2 = 0.03$, with Kindergarten children having higher amounts of self-talk compared to Year 1 children, $t(118) = 2.03$, $p = .045$, $d = 0.37$, but there were no significant differences in the amount of self-talk between Kindergarten and Preprimary children, $t(104) = .95$, $p = .346$, $d = 0.19$, and between Preprimary and Year 1 children, $t(106) = 1.01$, $p = .316$, $d = 0.20$. No other main effects or interactions were significant (all $p > .05$). To examine whether these effects were driven by inaudible muttering, private speech or social speech, a similar analysis was then performed for each type of self-talk individually. Means and 95% confidence intervals are presented in Figure 2.
Figure 2: Mean utterance per item and 95% confidence intervals for overall self-talk (inaudible muttering, private speech and social speech) at Time 1 (pre intervention) and Time 3 (post intervention) in children with SLI and their typically developing peers.

Inaudible Muttering Only

For inaudible muttering, there was a significant main effect of language group $F(1,160) = 138.50$, $p < .001$, $\eta_p^2 = 0.46$, with typically developing children producing more inaudible muttering than children with SLI. There was also a significant interaction between time and grade level, $F(2,160) = 4.37$, $p = .014$, $\eta_p^2 = 0.05$, but no other significant main
effects or interactions (all p > .10). Paired sample t-tests performed within each grade level revealed no significant increase in inaudible muttering from Time 1 to Time 3 for Kindergarten children, t(58) = -1.40, p = .168, d = -0.21, but a significant increase in inaudible muttering from Time 1 to Time 3 for Preprimary and Year 1 children, t(46) = -3.88, p < .001, d = -0.67 and t(60) = -5.35, p < .001, d = -0.84 respectively. Means and 95% confidence intervals are presented in Table 2.

**Private Speech Only**

For private speech, there was a significant main effect of language group, F(1,160) = 6.89, p = .010, η² = 0.04, and a significant interaction between time and language group F(1,160) = 29.81, p < .001, η² = 0.16. No other main effects or interactions were significant (all p > .10). Further examination of the time by language group interaction showed that children with SLI exhibited a significant increase in private speech from Time 1 to Time 3, t(86) = -7.00, p < .001, d = -0.87, while typically developing children did not, t(79) = 0.84, p = .406, d = 0.10. Means and 95% confidence intervals are presented in Table 2.

**Social Speech Only**

For social speech, the analysis revealed a significant main effect of language group, F(1,160) = 5.95, p = .016, η² = 0.04, grade level, F(2,160) = 9.86, p < .001, η² = 0.11, and a significant interaction between language group and grade level, F(2,160) = 3.21, p = .043, η² = 0.04. There was also a significant interaction between time and language group, F(1,160) = 7.22, p = .008, η² = 0.04. No other main effects or interactions were significant (all p > .10). Children with SLI showed no change in social speech from Time 1 to Time 3, t(86) = -1.28, p = .204, d = -0.15, whereas typically developing children showed a significant decrease in social speech across the same time period, t(79) = 3.04, p = .003, d = 0.34. Moreover, within the SLI group, there was no effect of grade level (p > .10), however, in the typically developing group, there was a significant decrease in social speech from
Kindergarten to Preprimary, $t(47) = 3.30, p = .002, d = 0.96$, but not from Preprimary to Year 1, $t(53) = 1.533, p = .189, d = 0.37$. Means and 95% confidence intervals are presented in Table 2.
Table 2

Means and 95% Confidence Intervals for Mean Utterances per Item for Inaudible Muttering, Private Speech and Social Speech in TD and Children with SLI at Time 1 (Pre-intervention) and Time 3 (Post-intervention)

<table>
<thead>
<tr>
<th>Group</th>
<th>n</th>
<th>Inaudible Muttering</th>
<th>Private Speech</th>
<th>Social Speech</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>M</td>
<td>95% CI</td>
<td>M</td>
</tr>
<tr>
<td>SLI Time 1</td>
<td>87</td>
<td>.04 [-.03,.12]</td>
<td>.91 [.61,1.21]</td>
<td>1.05 [.82,1.29]</td>
</tr>
<tr>
<td>Time 3</td>
<td></td>
<td>.34 [.21,.48]</td>
<td>2.19 [1.87,2.50]</td>
<td>1.20 [1.01,1.39]</td>
</tr>
<tr>
<td>Kindergarten Time 1</td>
<td>34</td>
<td>.09 [-.03,.20]</td>
<td>.80 [.33,1.27]</td>
<td>1.13 [.77,1.50]</td>
</tr>
<tr>
<td>Time 3</td>
<td></td>
<td>.19 [-.03,.40]</td>
<td>2.27 [1.78,2.76]</td>
<td>1.35 [1.06,1.64]</td>
</tr>
<tr>
<td>Preprimary Time 1</td>
<td>23</td>
<td>.00 [-.14,.14]</td>
<td>.85 [.28,1.43]</td>
<td>1.33 [.89,1.77]</td>
</tr>
<tr>
<td>Time 3</td>
<td></td>
<td>.31 [.05,.57]</td>
<td>2.15 [1.55,2.74]</td>
<td>1.23 [.88,1.58]</td>
</tr>
<tr>
<td>Year 1 Time 1</td>
<td>30</td>
<td>.02 [-.11,.15]</td>
<td>1.08 [.57,1.59]</td>
<td>.70 [.31,1.10]</td>
</tr>
<tr>
<td>Time 3</td>
<td></td>
<td>.55 [.32,.78]</td>
<td>2.14 [1.61,2.74]</td>
<td>1.03 [.72,1.34]</td>
</tr>
<tr>
<td>TD Time 1</td>
<td>80</td>
<td>.66 [.58,.73]</td>
<td>1.14 [.82,1.45]</td>
<td>.97 [.72,1.21]</td>
</tr>
<tr>
<td>Time 3</td>
<td></td>
<td>1.06 [.92,1.20]</td>
<td>.98 [.65,1.31]</td>
<td>.65 [.46,.85]</td>
</tr>
<tr>
<td>Kindergarten Time 1</td>
<td>25</td>
<td>.71 [.57,.84]</td>
<td>1.55 [1.00,2.10]</td>
<td>1.67 [1.24,2.09]</td>
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<tr>
<td>Time 3</td>
<td></td>
<td>.88 [.63,1.12]</td>
<td>1.34 [0.76,1.91]</td>
<td>1.06 [0.73,1.40]</td>
</tr>
<tr>
<td>Preprimary Time 1</td>
<td>24</td>
<td>.62 [.48,.76]</td>
<td>.79 [.22,1.36]</td>
<td>.74 [.30,1.18]</td>
</tr>
<tr>
<td>Time 3</td>
<td></td>
<td>1.11 [.85,1.36]</td>
<td>.99 [.40,1.58]</td>
<td>.55 [.21,.90]</td>
</tr>
<tr>
<td>Year 1 Time 1</td>
<td>31</td>
<td>.64 [.52,.76]</td>
<td>1.07 [.58,1.56]</td>
<td>.50 [.12,.88]</td>
</tr>
<tr>
<td>Time 3</td>
<td></td>
<td>1.17 [.94,1.39]</td>
<td>.61 [.10,1.12]</td>
<td>.34 [.04,.64]</td>
</tr>
</tbody>
</table>
Effect of Self-talk Training on TOL Performance

To examine whether self-talk training had any effect on the TOL performance of children with SLI, a 2 (time: Time 1, Time 3) by 2 (language group: SLI, typically developing) x 3 (grade level: Kindergarten, Preprimary, Year 1) mixed factorial ANCOVA was conducted on TOL scores with nonverbal IQ scores entered as a covariate. This analysis revealed a significant main effect of time, $F(1,161) = 160.77, p < .001, \eta_p^2 = 0.50$, with better TOL performance at Time 3. There was also a significant main effect of language group, $F(1,160) = 16.52, p < .001, \eta_p^2 = 0.09$, with typically developing children performing better than children with SLI, and grade level, $F(2,160) = 33.67, p < .001, \eta_p^2 = 0.30$, with Year 1 children performing better than Preprimary children, $t(106) = -3.21, p = .002, d = -0.63$, and Preprimary children performing better than Kindergarten children, $t(104) = -4.14, p < .001, d = -0.82$. Importantly, there were also significant time by language group, $F(1,160) = 16.91, p < .001, \eta_p^2 = 0.10$, and time by grade level, $F(2,160) = 3.74, p = .026, \eta_p^2 = 0.05$, interactions. To decompose the interaction between time and language group, paired samples $t$-tests were performed to examine the effect of time within the typically developing and SLI group separately. These revealed that while both groups showed a significant increase in performance on the TOL from Time 1 to Time 3, children with SLI showed a greater improvement, $t(86) = -11.17, p < .001, d = -1.2$, than typically developing children, $t(79) = -6.76, p < .001, d = -0.75$. Paired samples $t$-tests were also conducted to examine the effect of time within each grade level. These analyses showed that all three grade levels significantly improved on TOL performance, $t(58) = -7.72, p < .001, d = -1.08$, for Kindergarten, $t(46) = -6.91, p < .001, d = -1.16$, for Preprimary, and $t(60) = -7.39, p < .001, d = -1.13$, for Year 1. The main analysis also revealed a significant interaction between time and the covariate, nonverbal IQ, $F(1,160) = 6.26, p = .013, \eta_p^2 = 0.04$. To explore this interaction, we divided the children on the basis of IQ score into two groups: High average (100-125) and Low...
average (85-99). Independent samples t-tests revealed that the high average group performed significantly better than the low average group at Time 1, $t(169) = 2.74, p = .007, d = 0.47$, but not at Time 3, $t(169) = .74, p = .458, d = 0.13$. As there were a higher proportion of children with SLI in the Low average IQ group, it is not surprising that TOL scores at Time 1 were lower, however, importantly, after intervention, IQ scores were no longer associated with TOL performance. There were no other significant interactions, $p > .05$. Means and 95% confidence intervals are presented in Figure 3.

*Figure 3:* Mean TOL scores at Time 1 (pre intervention) and Time 3 (post intervention) in children with SLI and their typically developing peers.
Performance on TOL: Changes across Time (Time 1, 2 and 3)

To provide further evidence that self-talk Training played a causal role in the improvements in TOL performance evident in the SLI group, we examined changes in the TOL performance of children with SLI relative to the timing of self-talk Training. That is, we compared their performance at Time 1, when none of the children had received intervention, with Time 2, when half the children with SLI had received intervention (Training Group 1) and the other half of children with SLI were on the wait-list (Training Group 2), and Time 3, when all children with SLI had received intervention (see Figure 1). The typically developing children did not receive any intervention and formed the control group to assess developmental change. As the assignment to the Training Groups was not equal across grade levels, the ages of the children in each Training Group differed, \( t(85) = 3.94, \ p < .001, \ d = 0.86 \). Consequently, age was entered as a covariate in the following analyses.

A 3 (time: 1, 2 and 3) by 3 (intervention group: Training Group 1, Training Group 2 and TD control) mixed factorial ANCOVA conducted on the TOL scores with nonverbal IQ scores and chronological age entered as covariates revealed a significant main effect of time, \( F(2,324) = 14.82, \ p < .001, \ \eta^2_p = 0.08 \), and intervention group, \( F(2,162) = 14.82, \ p < .001, \ \eta^2_p = 0.16 \). Crucially though, there was a significant interaction between time and intervention group, \( F(4,324) = 15.97, \ p < .001, \ \eta^2_p = 0.17 \). Further analyses (pairwise comparisons) revealed that at Time 1 (pre intervention), the typically developing group performed better than both Training Groups, \( t(125) = -3.09, \ p = .002, \ d = -0.57 \), for Training Group 1, and \( t(118) = -4.05, \ p < .001, \ d = -0.79 \), for Training Group 2, which did not differ from each other, \( t(85) = 0.70, \ p = .486, \ d = 0.15 \). However, at Time 2, there was no difference between Training Group 1 and the typically developing group, \( t(125) = -0.85, \ p = .394, \ d = -0.16 \), but there was still a significant difference between Training Group 2 and the typically developing group, \( t(118) = -7.98, \ p < .001, \ d = -1.56 \), and also a significant difference between Training
Group 1 and Training Group 2, \( t(85) = 4.92, p < .001, d = 1.07 \). This shows that Training Group 1 improved significantly after intervention compared to Training Group 2. Finally at Time 3, when both SLI groups had received the self-talk Training, there were no significant differences between Training Groups 1 and 2 and the typically developing controls, \( t(125) = -0.81, p = .420, d = -0.15 \), and \( t(118) = -1.06, p = .291, d = -0.21 \), respectively. This indicates that Training Group 1 maintained their performance and Training Group 2 improved after self-talk training. There were no significant differences between Training Groups 1 and 2 at Time 3, \( t(85) = 0.39, p = .696, d = 0.09 \). Means and 95% confidence intervals are presented in Figure 4.

![Figure 4: Mean TOL scores at Time 1 (pre intervention), Time 2 (wait-list) and Time 3 (post intervention) in children with SLI and their typically developing peers.](image-url)
Effect of Self-talk Training on SDQ Scores

To examine whether self-talk training had any effect on hyperactive and inattentive behaviours, a 2 (time: 1, 3) x 2 (language group: typically developing and SLI group) x 3 (grade level: Kindergarten, Preprimary, Year 1) mixed factorial ANCOVA was conducted on the teacher rated SDQ scores for the Hyperactivity/Inattention subscale scores, with nonverbal IQ scores entered as a covariate. Children with SLI scored higher than typically developing children on the Hyperactivity/Inattention subscale, $F(2,158) = 22.06$, $p < .001$, $\eta^2_p = 0.12$. There were also significant time by language group, $F(2,158) = 10.70$, $p = .001$, $\eta^2_p = 0.06$, and time by language group by grade level interactions, $F(2,158) = 3.42$, $p = .035$, $\eta^2_p = 0.04$. No other main effects or interactions were significant (all $p > .10$). Further analysis revealed that the interaction between time and language group was significant for the Kindergarten children, $F(1,56) = 14.84$, $p < .01$, $\eta^2_p = 0.21$, but not the Preprimary or Year 1 groups (all $p > .05$). Within the Kindergarten group, children with SLI showed a significant decrease in SDQ scores for Hyperactivity/Inattention subscale from Time 1 to Time 3, $t(33) = 4.42$, $p < .001$, $d = 0.73$, but typically developing children did not ($p > .05$). Thus, Kindergarten children with SLI showed a reduction in their hyperactive and inattentive behaviours following the intervention. Means and standard deviations are presented in Table 3.
Table 3

Means and Standard Deviations for SDQ Hyperactive/Inattentive Subscales in Typically Developing and Children with SLI at Time 1 (pre-intervention) and Time 3 (post-intervention)

<table>
<thead>
<tr>
<th>Group</th>
<th>n</th>
<th>SDQ: Hyp/Inatt Subscale M (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SLI</td>
<td>86</td>
<td>SDQ: Hyp/Inatt Subscale</td>
</tr>
<tr>
<td>Time 1</td>
<td>34</td>
<td>5.56 (2.60)</td>
</tr>
<tr>
<td>Time 3</td>
<td>34</td>
<td>3.85 (2.08)</td>
</tr>
<tr>
<td>Preprimary</td>
<td>22</td>
<td>SDQ: Hyp/Inatt Subscale</td>
</tr>
<tr>
<td>Time 1</td>
<td>22</td>
<td>4.96 (2.57)</td>
</tr>
<tr>
<td>Time 3</td>
<td>22</td>
<td>4.50 (3.70)</td>
</tr>
<tr>
<td>Year 1</td>
<td>30</td>
<td>SDQ: Hyp/Inatt Subscale</td>
</tr>
<tr>
<td>Time 1</td>
<td>30</td>
<td>5.07 (3.16)</td>
</tr>
<tr>
<td>Time 3</td>
<td>30</td>
<td>4.43 (2.80)</td>
</tr>
<tr>
<td>TD</td>
<td>79</td>
<td>SDQ: Hyp/Inatt Subscale</td>
</tr>
<tr>
<td>Time 1</td>
<td>79</td>
<td>2.55 (2.76)</td>
</tr>
<tr>
<td>Time 3</td>
<td>79</td>
<td>2.57 (2.67)</td>
</tr>
<tr>
<td>Kindergarten</td>
<td>25</td>
<td>SDQ: Hyp/Inatt Subscale</td>
</tr>
<tr>
<td>Time 1</td>
<td>25</td>
<td>2.52 (2.62)</td>
</tr>
<tr>
<td>Time 3</td>
<td>25</td>
<td>2.76 (2.15)</td>
</tr>
<tr>
<td>Preprimary</td>
<td>24</td>
<td>SDQ: Hyp/Inatt Subscale</td>
</tr>
<tr>
<td>Time 1</td>
<td>24</td>
<td>2.50 (2.02)</td>
</tr>
<tr>
<td>Time 3</td>
<td>24</td>
<td>2.00 (2.36)</td>
</tr>
<tr>
<td>Year 1</td>
<td>30</td>
<td>SDQ: Hyp/Inatt Subscale</td>
</tr>
<tr>
<td>Time 1</td>
<td>30</td>
<td>2.63 (3.40)</td>
</tr>
<tr>
<td>Time 3</td>
<td>30</td>
<td>2.87 (3.25)</td>
</tr>
</tbody>
</table>

Note: SDQ: Hyp/Inatt Subscale = SDQ: Hyperactive and Inattentive Subscale
n = 1 typically developing and n = 1 children with SLI did not complete the SDQ at Time 3
Discussion

The first aim of this study was to evaluate the efficacy of a self-talk Training programme designed to increase the amount and quality of self-talk used by young children with SLI during planning. The results indicated that self-talk training increased the overall amount of self-talk produced by children with SLI from before to after self-talk training. In contrast, the overall amount of self-talk produced by typically developing children, who did not receive any self-talk training, did not change across the same time period. In terms of the nature of their self-talk, children with SLI showed a significant increase in private speech, but not social speech. Typically developing children, on the other hand, exhibited a reduction in social speech, but no changes in the amount of private speech from Time 1 to Time 3. Both groups showed an increase in inaudible muttering from Time 1 to Time 3 for the Preprimary and Year 1 groups, indicating that this increase was unrelated to the self-talk intervention.

The second aim of this study was to examine TOL performance before and after intervention to assess whether self-talk training led to any improvements in planning and problem solving for children with SLI. The results showed that both typically developing children and children with SLI performed better on the TOL at Time 3 relative to Time 1. However, as evidenced in Figure 3, the improvement in performance for children with SLI was much greater than for typically developing children. Moreover, the results indicated that the TOL performance of the children with SLI in Training Group 1 was significantly better at Time 2, after receiving self-talk Training, whereas Training Group 2, who did not receive self-talk Training during this time, showed no change in TOL performance at Time 2, but a significant increase in TOL performance at Time 3 after they received self-talk training. At Time 2, the TOL performance of children with SLI in Training Group 1 was no longer different from the typically developing children, whereas the TOL performance of children
with SLI in Training Group 2 was significantly weaker than typically developing children and the children with SLI in Training Group 1. However at Time 3, after both Training Groups had received self-talk training, there was no difference in the TOL performance of the three groups. This pattern of results strongly suggests that self-talk Training led to the improvements in planning and problem solving evident in the SLI group, to the point where the TOL performance of the children with SLI was comparable to their typically developing peers. The findings also rule out test-retest effects as the SLI Training Group 2, who did not receive intervention between Time 1 and Time 2, did not show a significant improvement on the TOL at Time 2. The pattern of results also indicates that the improvements are the result of intervention and not maturation, as the TD children did not show a significant improvement comparable to the children with SLI who received intervention.

The third aim of this study was to examine whether self-talk Training would help children to improve their self-regulation in the classroom. The results showed that children with SLI were rated as having less hyperactive and impulsive behaviours at Time 3 relative to Time 1, but only for the youngest group of children. Typically developing children showed no difference in their behavioural ratings across Time 1 and Time 3. These results could be interpreted as self-talk Training having more of an impact on the younger children within the SLI group, which is in agreement with Diaz et al. (1992), who found that after using sensitive verbal scaffolding to improve preschoolers self-talk, the teachers rated the children as less impulsive in the classroom. However, an alternative explanation is that the new school environment may have required a greater adjustment for Kindergarten children with SLI compared to typically developing children and older children with SLI, and so, they may have been rated as displaying more hyperactive and inattentive behaviours by their teachers in the earlier part of the year. As the school year progressed, these children may have shown a reduction in these behaviours as they settled into their environment. More thorough studies
on the impact of self-talk Training on behavioural self-regulation in the classroom need to be carried out using additional measures, such as behavioural observations, that could evaluate the impact of self-talk use in the classroom more precisely.

Taken together, the results for the TD children confirm the developmental trajectory of self-talk proposed by Vygotsky, namely, that self-talk gradually shifts from social speech to private speech and then becomes internalized as children age. In children with SLI, self-talk Training increased the amount of private speech they produced during planning and problem solving, but did not increase the amount of inaudible muttering any more than the increase shown by typically developing children who did not receive any intervention, suggesting that self-talk Training did not speed up the internalization of speech for these children. However, it could be that the two groups of children are at different stages of self-talk development and that for children with SLI, the self-talk Training helped in putting them on the developmental route, but was not able bring them up to the level of the TD children in terms of the quality of their self-talk. Nevertheless, the increase in self-talk evidenced in the SLI group was accompanied by better performance on the TOL and improved ratings on the behavioural measure. This is in line with Vygotsky’s theory that language is used for verbal mediation during cognitive processing and behavioural self-regulation. The improvements in planning and problem solving and behavioural ratings after self-talk training are also consistent with the study by Diaz et al. (1992), and extend their findings to a different population, namely, children with SLI.

The results of this study have several clinical implications. First, we have shown that a play-based self-talk training programme based on Vygotskian theoretical foundations can have a positive impact in terms of increasing the amount of self-talk in children with SLI. This is beneficial as it narrows the gap between children with SLI and their TD peers in terms of their use of self-talk. It is important to note that we neither taught nor encouraged children
with SLI to internalize their self-talk. This was not our aim. Rather, we wanted to scaffold the already existing self-talk in children with SLI to help them make use of their self-talk more effectively during planning and problem solving. Second, the self-talk training using Lego building led to improvements on a separate planning and problem solving task (i.e., TOL). This shows that the self-talk Training programme implemented in this study has the potential to improve general planning and problem solving skills, not just those specific to the training task. By the end of the self-talk training, there were no longer any differences between the planning performance of TD children and children with SLI. Thus, this study provides further support to the suggestion that verbal mediation is related to executive functioning performance (Winsler, et al., 2009). Third, self-talk Training is a viable option that can be used in specialized schools of early learning for children with SLI as a way to increase self-talk, to assist the development of planning and problem solving, and potentially improve behavioural self-regulation. This programme was well accepted by the children and educators in the Language Development Centres and may be of benefit to other children with SLI in their self-talk development. Given that self-talk has been linked to executive functioning, and self-talk training can improve self-talk and in turn assist Children with SLI in executive functioning, this area needs to be explored more thoroughly.

This study has several limitations. First, there was only one experimenter running the self-talk Training. This research needs to be replicated by other experimenters/therapists to ensure that the positive outcomes can be replicated across different contexts and were not due to an experimenter effect. Second, the follow up time from Time 2 to Time 3 was only 12 weeks. A longer follow-up period may be warranted to see if Children with SLI were able to maintain their self-talk and performance on the TOL over an extended period. This would also enable an examination of whether the self-talk of children with SLI continued to develop in terms of internalization. Third, as we did not test the children’s language directly, we do
not know if children with SLI with primarily receptive or expressive language impairments or both may differ in their self-talk and planning and problem solving performance. Thus, future studies need to test and categorize the diagnosis of SLI as mainly receptive language impairments, mainly expressive language impairments or a combination of both to examine possible differences in self-talk and executive functioning within the SLI population. Another issue that may arise due to not testing the children’s language directly is whether children’s vocabulary affects their gains in self-talk training. Children with higher vocabulary may benefit more from self-talk training as they have more vocabulary to use during planning and may be able to understand the therapist more than children with limited vocabulary. Thus, future studies should test the children’s language prior to intervention. Fourth, we did not measure the amount of self-talk practice the children did at home and in the classroom. Future studies may include a diary to record the practice at home and in class to document amount of practice beyond training sessions. Fifth, we only used a single measure of planning and problem solving, the TOL. Future research in this area could use a wider range of executive functioning tasks to explore other aspects of executive functioning before and after self-talk Training. Sixth, although the Holm-Bonferroni sequential correction for multiple comparisons showed that the main effect of interest (i.e., the time x language group difference) was still significant in all analysis following correction, we acknowledge that because of the large number of comparisons made, these analyses should be interpreted with caution.

**Conclusion**

This is the first study to implement a play-based self-talk Training programme for children with SLI and demonstrates the potential of self-talk Training as a tool to use in increasing self-talk among children with SLI. Furthermore, this study provides strong
evidence to suggest that language plays a causal role in the planning and problem solving of young children and highlights the potential for self-talk training to improve the cognitive and behavioural outcomes of children with SLI.
References


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Chapter 5

General Discussion
Self-talk has been found to play a major role in the development of cognitive skills and executive functioning in children. Given that children with SLI have delayed or deviant language in general, it is possible that they would also have delayed or deviant self-talk, with a concomitant negative impact on executive skills such as planning and problem solving. Thus, the first aim of this thesis was to examine the self-talk of children with SLI in the early school years (Kindergarten, Preprimary and Year 1) when the children are 4 to 7 years old. The first study of this thesis (Chapter 2) established the existence of a delay in self-talk in children with SLI. This led to the development of a play-based self-talk training programme based on the Vygotskian principles of sensitive scaffolding (Chapter 3). The effectiveness of this programme in increasing self-talk and improving planning and problem solving skills in a sample of children with SLI was then evaluated (Chapter 4).

In this General Discussion, the cross-sectional and intervention studies are briefly summarized and the results are discussed in more detail with particular attention paid to the broader implications, both practical and theoretical, of self-talk training in children. Potential methodological limitations along with suggestions for future research are also discussed.

5.1 Self-talk in Children with SLI Compared to Their Typically Developing Peers

Study 1 of this thesis presented in Chapter 2 was a cross-sectional study designed to provide a clear picture of the nature of self-talk in children with SLI in the earliest years of schooling and to document any changes that occur between Kindergarten and Year 1. To obtain a complete picture of the self-talk of these children we coded all forms of self-talk: social speech, private speech and inaudible muttering. The self-talk of 91 children with SLI was compared to that of 81 typically developing children across the three earliest grade levels (Kindergarten, Preprimary and Year 1) while they were engaged in a planning and problem solving task, the Tower of London (TOL). The large sample size enabled a detailed
examination of differences in self-talk across age groups and the impact of self-talk on planning and problem solving in young children with SLI and typically developing children. These comparisons were not possible in the two previously documented studies (Lidstone, Meins, & Fernyhough, 2012; Sturn & Johnston, 1999) of self-talk in children with SLI due to their limited sample sizes which did not allow comparisons across age groups, and so, the current research significantly extends this earlier work.

Another important aspect of this study was the examination of a subset of children with SLI that has received very little attention, those with elevated ratings of hyperactive and inattentive behaviours. This is the first study that has looked at the self-talk of children with SLI with hyperactive and inattentive behaviours and compared them to children with SLI without these hyperactive and inattentive behaviours and to typically developing children with elevated ratings of hyperactive and inattentive behaviours. We also examined the performance of this group on the TOL to see if having elevated levels of hyperactive and inattentive behaviours, although not a diagnosis of ADHD, would impair their planning and problem solving performance. Another novel aspect of this study was the investigation of the relationship between using self-talk and performance on individual items of the TOL. We were interested to see if self-talk use during planning and problem solving on the TOL would result in getting more items correct compared to being silent. We would then compare if there were any differences between typically developing and children with SLI in terms of the relationship between self-talk and planning performance.

The results of Study 1 showed that children with SLI and their typically developing peers produced the same amount of private speech, indicating that children with SLI do use self-talk during planning and problem solving. However, the nature of the self-talk used by the two groups differed. The self-talk of typically developing children followed the expected developmental trajectory: higher levels of social speech in the earliest grade level (i.e.,
Kindergarten) and less social speech in Preprimary and Year 1. This trajectory was delayed in children with SLI who were found to use a similar amount of social speech, which is a less mature form of self-talk, across all three grade levels. Moreover, perhaps most interestingly, the children with SLI produced almost no inaudible muttering, which indicated a delay in the internalization of self-talk. The results from this study suggest that there is a delay in both the development and internalization of self-talk in children with SLI. With regards to performance on the TOL, consistent with previous studies on planning and problem solving (Lidstone, et al., 2012; Marton, 2008), children with SLI showed significant impairment compared to their typically developing peers and by extension, executive functioning (Bishop & Norbury, 2005; Finneran, Francis, & Leonard, 2009; Henry, Messer, & Nash, 2012). Our study extended the previous studies by showing that the delay is evident at a very early age. In addition, our study highlighted the importance of coding all types of self-talk (i.e., social speech, private speech and inaudible muttering) when examining the self-talk of young children. By coding all types of self-talk, we obtained a clearer picture of the development of self-talk in the typical and atypical population.

Study 1 also showed that children with SLI and hyperactive and inattentive behaviours produced the same amount of self-talk overall, but a significantly higher amount of private speech compared to children with SLI without hyperactive and inattentive behaviours. This difference was not evident in the typically developing group. The lower performance of the subgroup of children with SLI with hyperactive and inattentive behaviours on the TOL indicates a double deficit: having hyperactivity and inattentive behaviours over and above language impairments further impedes their planning and problem solving performance as compared to having only language impairments without hyperactive and inattentive behaviours. This suggests that children with hyperactive and inattentive behaviours may use more private speech during planning and problem solving because they
also need to self-regulate their behaviour. That is, this group may need to use their self-talk for two concurrent functions: to plan and problem solve and to regulate their behaviour to be able to focus on the task at hand. Given the high proportion of children in the SLI group with hyperactive and inattentive behaviours, the question has been raised by Botting and Conti-Ramsden (2000) as to whether they really do have an attention and hyperactivity issue or whether their externalizing behaviour stems from their language impairment and not being able to adapt well to their environment. Not understanding what is expected of them and not being able to express their needs may cause some children with SLI to display more inattention and hyperactive-like behaviours, while other children with SLI may have more emotional and internalizing behaviour difficulties (Botting & Conti-Ramsden, 2000).

Nevertheless, from a practical standpoint, the presence of elevated levels of hyperactivity and inattention in addition to SLI is associated with significant impairment in terms of planning and problem solving performance compared to those without these behaviours.

The differential impact of hyperactivity and inattentive behaviours in typically developing children and those with SLI is interesting. This finding seems inconsistent with previous studies that have shown children with ADHD to have poorer planning and problem solving than those without ADHD (Corkum, Humphries, Mullane, & Theriault, 2008; Willcutt, Doyle, Nigg, Faraone, & Pennington, 2005). However, it is noted that these studies involved children diagnosed with ADHD while the present study simply involved children with elevated levels of hyperactivity and inattention as rated on a screening measure, the Strengths and Difficulties Questionnaire (SDQ: Goodman & Scott, 1999), hence the hyperactivity and inattention of the children in our study may have been less extreme than the children diagnosed with ADHD in these previous studies. This may have translated into milder cognitive sequelae for the typically developing children in our sample. Nonetheless, the results clearly indicate that the presence of hyperactive and inattentive behaviours further
impedes the already impaired planning and problem solving performance of children with SLI. It is possible that children with SLI and hyperactive and inattentive behaviours have limited compensatory strategies available to them to help them stay on track and plan and problem solve compared to typically developing children who have better language skills. Given that ADHD children are known to exhibit delayed self-regulation (Barkley, 1997, 2001), having hyperactivity comorbid with a language impairment may result in greater problems with using language for planning and sustaining attention on the complex cognitive task, leading to poorer performance for these children.

In our item-by-item analysis of TOL performance, we found a difference between typically developing children and those with SLI. Within the SLI group, a higher percentage performed better when they used self-talk compared to when they were silent. For the majority of typically developing children, it did not matter if they were silent or talking. This observation is intriguing. The question arises as to whether children with SLI who were silent lacked verbal thought to support performance on the TOL while typically developing children who were silent were using silent verbal thought (i.e., not exhibiting signs of self-talk as it is fully internalized). This question needs to be investigated further as we observed that children with SLI displayed virtually no inaudible muttering during the TOL, which is an indication of self-talk not being internalized. If this is the case, then children with SLI who were silent may not be using verbal mediation as a strategy during planning and problem solving tasks while children with SLI who have private speech or social speech use self-talk to aid problem solving.

5.2 Talk to Think Programme, Self-talk Training Effectiveness Study

Based on the findings from the first study in this thesis, and previous studies showing the link between verbal mediation and planning (Al-Namlah, Fernyhough, & Meins, 2006;
Fernyhough & Fradley, 2005), we hypothesized that if we could intervene and assist children with SLI to improve their self-talk, we could in turn improve their planning and problem solving and, by extension, their executive functioning. We therefore designed a self-talk training programme for children with SLI, specifically targeting self-talk during planning and problem solving. Talk to Think is a play-based self-talk training programme that is grounded on Vygotskian principles of sensitive scaffolding, requires an interpersonal collaboration between the adult and each child, and uses the children’s pre-existing repertoire of language to build more self-talk for planning and problem solving. We hypothesized that a programme designed to encourage self-talk use, wholly implemented in schools of early learning with continued reinforcement by teachers and parents, would be helpful in improving children’s self-talk. The Talk to Think objective was to increase the quantity and quality of children’s self-talk, particularly their overt self-talk. It is important to note that we did not attempt to speed up the internalization of their self-talk as, following Vygotsky, we considered it to be a counter-productive endeavour in the early years when children with a language delay are just starting to master the use of self-talk for planning and problem solving. Instead, we viewed internalization as a process that develops with age after the overt use of self-talk has been well established. Sub-vocalization, as used in self-instructional training in the 1970-1980s, is different from the Vygotskian notion of internalization of self-talk to complete verbal thought, where the former is merely repeating overt self-talk covertly, much akin to cognitive rehearsal, and the latter is using verbal mediation as a tool to facilitate thought (Diaz & Berk, 1995). The effectiveness of the Talk to Think self-talk training programme was assessed using a wait-list intervention design implemented with the children with SLI who were participants in the first study. This wait-list intervention study (Study 2) is reported in Chapter 4. The scale of the intervention was large, involving 87 children with SLI from five suburban areas, which enabled the results to be interpreted with confidence.
The aims of Study 2 were: 1) to examine the effectiveness of a self-talk training programme in improving self-talk in children with SLI, 2) to compare TOL performance before and after self-talk training and 3) to monitor behaviour regulation, specifically hyperactivity and inattention, before and after self-talk intervention. Children with SLI were divided into two groups, Training Groups 1 and 2 who received the intervention at different time points. Training Group 1 received self-talk training first, between Time 1 and 2. Training Group 2 was wait-listed and received self-talk training after testing at Time 2, before retesting at Time 3. The typically developing children formed a control group which did not receive any intervention.

Results from the intervention study showed promising results for self-talk training in that the Talk to Think programme was effective for increasing self-talk, particularly private speech, in children with SLI. There were no changes in the overall self-talk of the typically developing controls over time, but there was a significant increase in the inaudible muttering of the Preprimary and Year 1 typically developing children. Children with SLI showed a similar increment in inaudible muttering from Time 1 to Time 3 for the Preprimary and Year 1 children, indicating that this increase was most likely due to developmental maturation and not the self-talk intervention. It should be noted, however, that despite this increase, the amount of inaudible muttering at Time 3 in Year 1 children with SLI was still less than the amount of inaudible muttering of typically developing children in Kindergarten, indicating that children with SLI are still delayed in their self-talk internalization. This is in line with Vygotsky’s proposed developmental trajectory of overt speech becoming more internalized as children age. In terms of TOL performance, we tested all children on isoforms of the TOL at three time points: Time 1 (pre-intervention), Time 2, when Training Group 1 had received intervention and Training Group 2 had not, and Time 3, when Training Group 2 had received intervention and Training Group 1 had not received any additional intervention. The results
showed that at Time 2, the TOL performance of the children with SLI in Training Group 1 had improved following self-talk training, while the children in Training Group 2 did not show any improvement in their TOL performance. However, the TOL performance of Training Group 2 improved between Time 2 and Time 3 after receiving self-talk training, and Training Group 1 maintained their performance. The TOL performance of both the typically developing children and the children with SLI significantly improved from Time 1 to Time 3, but the gains in the SLI group were larger, and by Time 3 there were no longer any significant differences between the TOL performance of typically developing children and those with SLI. This provides strong evidence that when self-talk improves, planning and problem solving is enhanced. As the tasks used in the training programme and the pre-and post-testing were different, it is apparent that the children were able to generalize the self-talk skills learned in the training programme to an unrelated activity. This is important because it shows the potential of self-talk training to improve children’s functioning in other areas that require planning and problem solving, both at home and in the classroom.

Although the results indicated that children with SLI improved their self-talk following training, their self-talk was still not at the same developmental level as typically developing children as they showed less internalization, a sign of maturity of self-talk. Moreover, unlike typically developing children who showed a significant reduction in social speech over time, children with SLI did not demonstrate a reduction in social speech. Thus, it seems that self-talk training can help place children who have delays in self-talk on the developmental path by increasing the amount of self-talk, particularly private speech, but internalizing self-talk to inner speech and verbal thought requires developmental maturity.

When considering changes in behaviour regulation in the classroom post-intervention, we found that children with SLI displayed less hyperactive and inattentive behaviours as rated by their class teachers, but only in Kindergarten. This could be interpreted either as self-
Talk having a greater impact on younger children’s behaviour in reducing their hyperactive and inattentive behaviours, or as kindergarten children with SLI requiring a greater adjustment at the beginning of the school year compared to older children with SLI and typically developing kindergarten children. This could lead to kindergarten children with SLI being rated as being more hyperactive and inattentive at the beginning of the year than at the end of the year, when they had settled into their routine and were more regulated. With the reduction in hyperactive and inattentive behaviours reported by teachers, the number of children rated as displaying elevated hyperactive and inattentive behaviours in the SLI group dropped from 31 children at pre-intervention to 19 children post-intervention. While this in itself is promising, and is another indicator of the effectiveness of the training programme, the small number of these children post-intervention limited our ability to analyse any changes in their self-talk and self-regulation after self-talk training. Consequently, we were unable to draw strong conclusions regarding the effectiveness of the self-talk training programme for this particular subset of children with SLI. However, one indication that the change could be due to the intervention programme can be found in the comments of teachers whose students participated in the programme. Teachers reported an improvement in the children’s level of attention and focus, one of the core objectives in the Talk to Think programme, and said that their students used self-talk to manage their attention and focus during classroom sessions. As no formal feedback tools were used to gather teachers’ impressions, some measures such as behavioural observation would be beneficial to look at the effectiveness of self-talk training on the self-regulation of children at risk of hyperactive and inattentive behaviours in the classroom.

Thus, overall, self-talk training using Vygotskian principles of sensitive scaffolding and Meichenbaum’s framework of teaching children to focus, pay attention, plan step-by-step and asking for help has been shown to be effective in increasing self-talk in children with SLI.
and, as a result, narrowing the gap between the planning and problem solving performance of children with SLI and their typically developing peers.

5.3 Theoretical Considerations

The research described in this thesis is strongly grounded in Vygotskian theory and provides further evidence for Vygotsky’s views on the trajectory of self-talk development. It also demonstrates that his theory applies to special populations such as children with SLI. Vygotsky believed that children’s self-talk develops from overt social speech through interaction with others, to private speech, and then becomes internalized to covert speech and complete verbal thought. The first study of this thesis found that in typically developing children, this is indeed the case: Kindergarten children produced more overt speech than Preprimary and Year 1 children, showing that self-talk during planning and problem solving progresses from overt to covert speech as children age. In children with SLI, we found that while they do have self-talk, and use it during planning and problem solving, they have less self-talk overall and very little inaudible muttering, which suggests a delay in their self-talk development. That is, they are following the developmental trajectory suggested by Vygotsky, but are at an earlier point than their typically developing peers.

Study 2 demonstrated the effectiveness of a self-talk training programme based on Vygotskian principles in increasing self-talk and subsequently improving planning and problem solving and reducing hyperactive and inattentive behaviours in children with SLI. This provides strong support for Vygotsky’s position that children’s executive functioning and self-regulation develop through language, and that self-talk is vital for planning and problem solving and self-regulation. The self-talk training was based on Vygotsky’s views that children are active learners, and that learning should be age appropriate, play-based and interactive. The success of our self-talk intervention also reinforces the value of adhering
consistently to the processes proposed by Vygotsky to be integral to the development of self-talk. Children’s planning and problem solving was scaffolded using self-talk appropriate for the children’s age and language ability and the Lego building tasks were customized to ensure that they were challenging but could be done by children with support from an adult.

In addition to the self-talk training that was implemented by an experimenter, the reinforcement of self-talk at home and in the classroom through continued collaboration with parents and teachers is likely to have helped the self-talk development of children with SLI. Providing parents and teachers with the necessary skills and knowledge to reinforce self-talk training in the home and especially in class, allowed continued use of self-talk and consolidation of the skills that were recently learnt during the Talk to Think sessions. The experimenter spent about 15 minutes with each class teacher prior to each session and during this time, explained the plan for the day’s session and received feedback about the self-talk used in the classroom. This continual collaboration with class teachers allowed two-way feedback and dynamic changes to the sessions of the Talk to Think programme for each intervention group. Feedback from class teachers about the use of self-talk in the classroom helped the experimenter to review certain concepts that were unclear to the children or reinforce good use of self-talk with praise. Parents also reported that they thought the self-talk training programme was useful and the materials provided to them helped them to understand the value of their children’s self-talk. The collaborative nature of the self-talk training coupled with the success of the programme provides some support for Vygotsky’s theory that self-talk is learnt from the social interaction with significant others in children’s lives such as their parents and teachers. To provide stronger evidence for this claim, it would be necessary to examine the effectiveness of the Talk to Think programme both with and without parent and teacher collaboration, to examine the extent to which social interaction with others is critical for the success of the programme.
The Talk to Think programme incorporated Meichenbaum and Goodman’s main themes in Self-Instructional Training (Meichenbaum & Goodman, 1971). This was important given that this intervention programme is designed to be implemented in schools and the central themes in Self-Instructional Training involve behaviours typically valued in the school setting: the importance of paying and sustaining attention, recalling a task when distracted, being aware of cues of distraction, being aware of the task at hand and planning in sequential steps, and asking for assistance when needed and remembering what to do.

However, we did not follow their method of explicit teaching of overt verbalizations by an adult experimenter as this has been found to be ineffective in changing self-talk and behaviour in children (Diaz & Berk, 1995). Diaz and Berk (1995) suggested that the reason Meichenbaum and Goodman’s self-instructional training was not successful with children was because it failed to adhere to Vygotskian principles in terms of the process of scaffolding self-talk as well as in the method of teaching self-talk. For these reasons we implemented the Talk to Think programme using processes and principles advocated by Vygotsky. We demonstrated, consistent with Vygotsky’s claim, that self-talk can be scaffolded, and that children who have delays in self-talk can be trained to be able to use their self-talk more effectively for planning and problem solving and, possibly, self-regulation. While the effectiveness of this program has yet to be replicated, these data suggest that Diaz et al. (1992, 1995) was correct in claiming that self-talk training strongly grounded in Vygotskian principles can help children improve their planning and self-regulation.

The results of Study 2, showing the effectiveness of our self-talk training programme, also supported the Cognitive Complexity and Control theory of Zelazo, Müller, Frye, & Marcovitch (2003) by showing that increased self-talk led to better planning and problem solving performance and, by extension, executive functioning. Zelazo and colleagues stated that self-talk provides a medium by which children are able to be more aware of their current
thoughts and actions, thus allowing them to reason better, and providing a link to the consequences of actions. Consistent with this, during post-intervention testing on the TOL, it was observed that children with SLI often used self-talk that guided their behaviour, such as, “I need to look carefully” “The next step is this…” “Now I got to” “Hang on, I have to think”. Zelazo et al. (2003) also state that as children age, they gain more mastery and control over their cognition and executive functioning through verbal mediation. Thus, in the case of children with SLI, if self-talk training can be used to enhance their self-talk, the gains they achieve in their self-talk development following self-talk training may also help them to use their self-talk more effectively during cognitive and executive functioning tasks.

5.4 Clinical implications of findings

Given that this thesis focused on self-talk in children with SLI and is oriented towards an applied intervention to help improve self-talk in children through training, there are a number of clinical implications from both studies.

Study 1 (the cross-sectional study) demonstrated the importance of conducting behavioural and executive functioning assessments in children with SLI. Children at risk of SLI are typically assessed with an intelligence test, a language assessment, and an adaptive behaviour assessment for a diagnosis of SLI. They are not usually assessed for executive functioning or difficulties with attention and hyperactivity. After diagnosis, and especially after placement in a specialised school or programme or when receiving additional classroom support, young children with SLI would benefit from behavioural screenings, carried out periodically (e.g., every 3 months) by a teacher and/or parent to provide an ongoing picture of the child’s behaviours at home and at school. A screening test such as this would signal if more assessment and/or intervention was necessary to assist the child. Study 1 showed that in children with SLI, those with hyperactive and inattentive behaviours were significantly
impaired in terms of planning and problem performance solving relative to children without hyperactive and inattentive behaviours, despite the groups being equated on nonverbal IQ. Thus, these children may have a ‘double deficit’ in terms of their planning and may require more assistance and intervention compared to those with SLI only.

Periodical behaviour screening is not only likely to be beneficial, it is also achievable in most school settings. The Strengths and Difficulties Questionnaire (SDQ) (Goodman & Scott, 1999) that we used in this study is a short 25-item questionnaire with forms for both parents and teachers, which takes approximately 5-10 minutes for an adult to complete. It has been translated into over 30 different languages with norms available for several countries (Mellor, 2004). It also has online scoring that is provided by the test provider and can be used by teaching assistants. The SDQ correlates well with more comprehensive behavioural measures such as the Child Behaviour Checklist (CBCL) (Goodman & Scott, 1999). We consider the SDQ to be an economical, viable and efficient tool to monitor behavioural changes in children, particularly hyperactivity and inattention, which has been shown to be elevated in a significant proportion of children with SLI. Furthermore, with the recent change to the DSM-V that allows for comorbid diagnoses of ADHD and language disorders, continued monitoring of hyperactive and inattentive behaviours in children with SLI will help identify children who might require further assessment, diagnosis and management of ADHD.

Study 1 also highlighted the importance of conducting executive functioning assessments for children with SLI as they were shown to have a significant deficit in planning and problem solving in this study, in line with other studies of executive functioning in children with SLI (Henry, et al., 2012; Lidstone, et al., 2012; Marton, 2008). Over and above intelligence, language, and adaptive behaviour assessments, executive functioning assessments should be carried out for children with SLI as executive functions are thought to
control and regulate children’s thoughts and actions. Growing evidence indicates that many aspects of executive functioning are not measured in intelligence tests, thus, although related to intelligence (Miyake, Emerson, Padilla, & Ahn, 2004), executive functioning abilities are separate and need to be assessed separately to capture children’s abilities comprehensively, especially in children with SLI who have at least average nonverbal IQ but have deficits in executive functioning (Friedman et al., 2006).

Assessing executive functioning is vital as deficits, especially impairments in planning and problem solving, can lead to various learning and social skills deficits, many of which are frequently displayed by children with SLI in their primary and secondary school years. Executive function deficits, including impairments in planning and problem solving, have been linked to impaired academic performance (Biederman et al., 2004; Bull & Scerif, 2001; Latzman, Elkovitch, Young, & Clark, 2010), social skills (Blakemore & Choudhury, 2006) and poorer emotional regulation (Gioia, Isquith, Guy, & Kenworthy, 2000) in children and adolescents. Given the link between executive functioning and academic achievement and social and emotional well-being in children, the likely outcomes for children with SLI, especially those with hyperactive and inattentive behaviours, are concerning. Previous research with older children with SLI indicates that they perform lower on virtually every academic task (Cohen, Barwick, Horodezky, Vallance, & Im, 1998; Donlan, Cowan, Newton, & Lloyd, 2007; Young et al., 2002) and display poorer emotion regulation and social skills (Botting & Conti-Ramsden, 2000; Cohen & Menna, 1998) with these difficulties continuing well into adolescence. This, in turn, may lead to social isolation, anxiety and depression (Botting & Conti-Ramsden, 2000; Conti-Ramsden, 2008).

Results from Study 2 of this thesis shows the importance of self-talk in regard to planning and problem solving in children. Although children with SLI did not reach the same level of maturity in their self-talk as their typically developing peers, being able to use
effective overt self-talk helped them to improve their planning and problem solving performance. Thus, children with SLI should be encouraged to use their overt self-talk in their classroom and at home. Allowing self-talk in the classroom and not expecting total silence during class activities would be beneficial for children with SLI as they would be able to use their overt self-talk more frequently. Overt self-talk would also allow teachers to observe the child’s planning and thinking and enable them to better guide the children. However, the use of self-talk would increase the noise level in the classroom, and therefore, teachers would need to be aware of this and only allow children to use self-talk overtly when appropriate. For example, they could have a specific planning time that allows overt self-talk.

The self-talk training programme could also be implemented in schools of early learning by existing staff members such as a speech pathologist or school psychologist or modified to be implemented in the classroom by teachers as part of an intervention to improve language, to assist the development of planning and problem solving, and potentially improve behavioural self-regulation. This programme was well-accepted by the children and educators in the Language Development Centres and has the potential to be of benefit to other children with SLI in terms of their self-talk development.

5.5 Limitations

This thesis has several limitations. The first study used a cross-sectional design that examined three age groups at one point in time instead of following the planning and problem solving of the same group of children over time. This was necessary for pragmatic reasons. However, this meant that we could not establish a developmental trajectory in children with SLI or determine whether the apparent delay we observed in their development is due to a cohort effect. To ascertain this, longitudinal studies are needed. It would also be valuable to
follow children beyond grade one into middle childhood to determine whether children with SLI follow the trajectory of their typically developing peers.

Although the numbers of children with hyperactive and inattentive behaviours in both the SLI and typically developing group are proportional to the numbers occurring in the population (Cohen et al., 2000), the small numbers, especially among the typically developing children, limited our ability to look at the effect of hyperactivity and inattention at each grade level. Future studies would need to increase the number of this subset of children to gain a better understanding of their self-talk during planning and problem solving across grades.

Another potential limitation is that we did not measure working memory in our sample. Studies have shown that children with SLI have significantly poorer working memory compared to typically developing children (Archibald & Gathercole, 2006; Marton & Schwartz, 2003), and so, it would have been beneficial to assess whether the group differences evident in planning and problem solving were due to problems with working memory and also the link between self-talk and working memory performance. However, finding a working memory test that could be understood by very young children with SLI, particularly those with hyperactive and inattentive behaviours, would have been extremely difficult and the validity of the results from any such test questionable. If this study were to be extended to include older children with SLI, then it would be worthwhile to include a measure of working memory to assess the relationship between working memory and self-talk and problem solving.

The use of a single score on the TOL to measure planning and problem solving could also be considered a limitation. However, this is in line with several previous studies (Lidstone, Meins, & Fernyhough, 2010; Lidstone, et al., 2012; Marton, 2008). Although our TOL had 21 items (including practice items) ascending in difficulty from 2-7 move problems,
not all children were able to complete all the items. Testing was discontinued after children failed 3 consecutive items to minimize discomfort. Kindergarten children with SLI and those with hyperactive and inattentive behaviours had the most difficulty and stopped earlier on the TOL items. This resulted in children stopping at varying levels of difficulty. Therefore, it was not possible for us to use the time taken or total number of moves as performance measures, as children who completed more (and hence more complex) items took more time on each item as they progressed. To address the aim of comparing the planning and problem solving performance of children with SLI with that of typically developing peers, a single measure of TOL performance was considered adequate as well as feasible.

5.6 Future Directions

Research investigating the self-talk of children with SLI still requires further attention to address many unanswered issues. Future studies need to include a microgenetic analysis of the self-talk of children with SLI compared to their typically developing peers while completing a task with different levels of difficulty. Microgenetic studies consist of repeated observations of the same group of children either i) performing the same task over a short period of time, or ii) engaging in multiple trials of the same task (usually with varying levels of difficulty) in one session or iii) both. This would enable the examination of possible differences in self-talk at different levels of difficulty, and the self-talk produced during novel and repeated task exposures. It would also enable further exploration of the relationship between self-talk and cognitive performance. Such studies would be beneficial in extending our understanding of the nature of the self-talk delay in children with SLI.

Future studies could also attempt to use articulatory suppression as an alternative way of studying self-talk in children with SLI. While this was not a possibility for the young children in our study, given the constraints of providing understandable instructions for
Kindergarten children with SLI, using articulatory suppression in future studies with an older cohort of children with SLI is warranted.

It is important that the effectiveness of the self-talk training programme is replicated with a different SLI sample and, as only one person carried out the intervention programme in this study, with different experimenters to ensure that the results obtained were not simply an experimenter effect. Future research could also employ an active control group to enhance the study design, where instead of being on a wait-list, a control group would receive Lego play without any self-talk training components. We did not do this for practical and ethical reasons. Having an active control group would have meant taking children out of class in a specialised programme for a total of 5 hours a term to have free play with Lego. We decided that this was not in the best interest of the children, and that a wait-list intervention design was the most viable option given the circumstances.

In addition, examining the self-talk and executive functioning of different categories of children with SLI (mainly receptive, mainly expressive and both receptive and expressive impairments) separately, by using a larger sample, would provide a better understanding of the nature of self-talk in children with SLI and enable an examination of whether they respond to self-talk training differently. Children with receptive language impairments may have more difficulties with comprehension of the self-talk training and may not grasp the concepts as well as children without receptive language impairments. On the other hand, children with expressive language impairments may have problems with expressing and using self-talk. Examining self-talk and the effectiveness of a self-talk training programme in these populations of children with SLI separately will enable further development of Vygotsky’s theory by assessing whether it is interaction with others or the act of talking to oneself that is more important in self-talk development.
With the recent changes to the DSM-V allowing for comorbid diagnoses of a language disorder and ADHD, children with SLI could also be further divided into three groups, SLI with ADHD, SLI with hyperactive/inattentive behaviours not amounting to ADHD, and SLI without ADHD or hyperactive/inattentive behaviours, to examine differences in self-talk and executive functioning. This would be important to assess whether children diagnosed with ADHD and comorbid SLI have more or different deficits in executive functioning compared to children with SLI with hyperactive and inattentive behaviours not amounting to ADHD. Obtaining suitable sample sizes is difficult in self-talk research as coding and transcribing the speech of children, particularly children with language impairments, is a labour-intensive affair. However, these sub-categorizations, would allow a much clearer picture of the nature of self-talk in children with SLI.

Finally, further studies using additional measures of planning and problem solving, as well as other executive measures such as inhibition and set shifting, would be useful to further understand children’s self-talk during executive functioning tasks and to examine whether the benefits of self-talk training generalize to performance on other executive function tasks such as inhibition and switching. This would also extend our understanding of the relationship between self-talk and cognition.

**Concluding Remarks**

This thesis provides a unique insight into the self-talk of children with SLI and its impact during planning and problem solving. This is the first study to examine self-talk during planning and problem solving in young children with SLI using a large sample that includes a subset of children with SLI with hyperactive and inattentive behaviours. Talk to Think is a novel self-talk training programme designed specifically for children with SLI.
using Vygotskian principles of self-talk training and its effectiveness was tested using a wait-list intervention study design.

The results established a delay in self-talk development in young children with SLI and demonstrated that this delay is associated with impairments in their planning and problem solving. In addition, this thesis highlights the importance of identifying children with SLI with hyperactive and inattentive behaviours as it was found that these children have a double deficit that is associated with further impairment in their planning and problem solving compared to children with SLI without hyperactive and inattentive behaviours. Furthermore, this thesis showed that self-talk training carried out using Vygotskian principles is effective in increasing private speech and subsequently improving planning and problem solving performance in children with SLI, lending support to Vygotskian theory that self-talk is socially mediated and plays a vital role in planning and problem solving.

This thesis highlights the importance of executive functioning and behavioural assessments in young children with SLI. Subject to replication, it also highlights the potential of early intervention using self-talk training to increase self-talk and improve planning and problem solving and, by extension, executive functioning in children with SLI. This thesis provides a strong basis from which to navigate the many yet to be answered questions with regards to self-talk in children with SLI that we anticipate will be answered within the next few years. Future research is warranted to provide a clearer picture of the self-talk used by children with SLI and a more comprehensive understanding of their development as well as the provisions required for successful early interventions to ensure better outcomes for these children.
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