



When words lead to solutions: Executive function deficits in preschool children with specific language impairment



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ABSTRACT

Several studies indicate that school-age children with specific language impairment (SLI) have difficulties with tasks that rely on executive functions. Whether executive function deficits in children with SLI emerge during preschool age remains unclear. Our aim was to fill this gap by investigating executive function performances in two age groups of preschoolers with and without SLI. Children with SLI ($N = 60$; young: 53.6 ± 5.3 months; old: 65.4 ± 3.8 months) and age-matched control children ($N = 58$) were tested for problem-representation ability, using the Flexible Item Selection Task (FIST), rule-use skills, using a Stroop-like Day–Night test (D/N), and planning skills, using the Tower of London test (TOL). Older children performed better than younger children did across tasks. Children with SLI had poorer performance, compared to typically developing children, on measures of problem representation, planning skills, and use of rules. Our results clearly indicate that executive function impairment is evident during the preschool period. Although old children with SLI performed better than young children with SLI, their performances were still poor, compared to those of control peers. These findings suggest that children with SLI have altered executive functioning at 53.6 months.

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1. Introduction

During a child's early development, motor, language acquisition and executive functioning abilities are clearly interdependent. For example, the age of verb acquisition and proficiency in using the body to perform the corresponding action are correlated (Maouene, Hidaka, & Smith, 2008), and early simultaneous use of speech and hand movements may be a predictor of later language development (Iverson & Goldin-Meadow, 2005). Furthermore, children are able to bodily produce actions related to verbs before they are able to verbally produce the linguistic labels associated to them (Levi, Colonnello, Giacchè, Piredda, & Sogos, 2014). The progressive mastering of bodily actions plays a key role for the early language acquisition and cognitive processes (Merleau-Ponty, 1945/1962; Piaget & Inhelder, 1966/1969; Clark, 1997; Iverson, 2010). In childhood, the language becomes a mean for expression of actions, for reflection of one's own performed actions, and planning of future potential ones. The externally directed language is progressively internalized and used to self-direct one's own external behavior to solve problems (Marcovitch & Zelazo, 2009).

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In this view, the study of language development and related disorders may not be considered independently from other abilities and cognitive processes. Thus, the aim of the present study is to further the understanding of relations between language and executive functioning development during problem solving tasks in children with language disorder.

Specific language impairment (SLI) is a common developmental disorder that primarily impairs language and speech abilities and is not related to/or caused by other developmental disorders, such as hearing loss or acquired brain injury (Leonard, 1998). Although this disorder is designated as “specific” because of the absence of impairment in other aspects of intellectual development, deficits are not entirely restricted to the language domain. For example, several studies have demonstrated that school-age children with SLI have poor performances on measures of fine and gross motor abilities (Finlay & McPhillips, 2013; Iverson & Braddock, 2011; Zelaznik & Goffman, 2010; Hill, Bishop, & Nimmo-Smith, 1998) and procedural memory (Lum, Conti-Ramsden, Page, & Ullman, 2012). In addition, children with language disorders show impairment in imitation skills, kinesthetic awareness (Marton, 2009), and processing of simultaneous information (Marton & Schwartz, 2003; Marton, Schwartz, Farkas, & Katsnelson, 2006). Recent studies indicate that school-age children with language impairment perform poorly compared to typically developing peers on measures of mental attention, interruption, and updating (Im-Bolter, Johnson, & Pascual-Leone, 2006). Furthermore, as Bishop and Norbury (2005a,b) have demonstrated, children with communication impairments are more likely to have difficulties during inhibition tasks. Children with SLI also generally show poor performance in concept generation, cognitive flexibility, visual–spatial planning, and in visual–spatial tasks with high executive function demands (Marton, 2008), all of which have obvious detrimental effects on the learning process.

The relations between SLI and executive functions have mainly been investigated in school-age children. However, given the importance of detecting manifestations of difficulties in early development and given the strong relation between bodily actions, language and reasoning, the question arises whether preschool-age children with SLI show poor executive functioning in problem solving tasks. Although language and inner speech acquisition play crucial roles in the development of executive functions and problem solving (Ferryhough & Fradley, 2005; Vygotsky, 1987), relatively little is known about possible impairments of executive functions in preschool children with SLI.

According to classic neuropsychological theories and recent experimental studies, children’s ability to plan, monitor, and regulate their own behavior increases between the ages of four and seven, along with the development of self-directed speech (Ferryhough & Fradley, 2005; Alarcón-Rubio, Sánchez-Medina, & Prieto-García, 2014; Luria, 1961; Luria & Yudovich, 1971). However, changes in several aspects of executive functions occur in the preschool period (Hongwanishkul, Happaney, Lee, & Zelazo, 2005; Jacques, Zelazo, Kirkham, & Tanya, 1999; Jacques & Zelazo, 2001). Specifically, children with typical development progressively acquire representational flexibility (i.e., the ability to manipulate representations) and response control to follow rules (Zelazo, Reznick, & Spinazzola, 1998; Jacques & Zelazo, 2001). These abilities are considered fundamental for several problem solving tasks, such as the classification of items (Piaget & Inhelder, 1966/1969), imitation, and perspective taking tasks (Simcock & DeLoache, 2006).

In this framework, we hypothesized that alterations of executive function development in children with SLI also emerge during the preschool period. Because problem solving is considered to be the main outcome of executive functions (Zelazo & Frye, 1997; Zelazo & Müller, 2002), we examined whether children with a diagnosis of SLI have more difficulties than do their typically developing peers regarding problem representation, planning, and execution of plans. To better analyze early manifestations of executive function difficulties and to shed light on the developmental course such deficits in children with SLI, we contrasted the performances of two age groups.

We predicted that children with SLI would perform worse than children with typical development on all the tasks. In addition, we predicted that both young and old children with SLI would perform worse than control children on all the tasks.

2. Methods

2.1. Participants

All children came from Italian-speaking families and were monolingual. Children in the study were placed into a language group, SLI or control. The SLI group consisted of 60 children, while the control group consisted of 58 children with typical development. Within each language group, children were divided into two age groups: young children (SLI-young: 24 boys, 6 girls, age: $M = 53.6$ months, $SD = 5.3$; Control-young: 11 boys, 18 girls, age: $M = 53.4$ months; $SD = 2.7$) and old children (SLI-old: 25 boys, 5 girls, age: $M = 65.4$ months, $SD = 3.8$; Control-old: 11 boys, 18 girls, age: $M = 66.1$ months, $SD = 3.4$).

Children with SLI were referred to the Division of Child Neuropsychiatry of University of Rome “Sapienza,” because of language delay. They were included in the study after diagnosis by a specialized interdisciplinary group composed of a child psychiatrist, a developmental rehabilitation therapist, and a psychologist.

Assessment of SLI included administration of the Rustioni test of language comprehension (Rustioni, 1994), the Peabody receptive communication test (Peabody Picture Vocabulary Test III, Dunn & Dunn, 1997), and the Italian translations of the Wechsler Intelligence Scale for Children–Revised (WISC-R; Rubini & Padovani, 1986, Table 1). Among the inclusion criteria for the group with SLI were impaired vocabulary comprehension and morphosyntactic production (Cipriani et al., 1993). Exclusion criteria were rehabilitation center enrollment, a history of socio-economic deprivation, $IQ < 85$, and hearing deficits.

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