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Grasping the World Through Words: From Action to Linguistic Production of Verbs in Early Childhood

ABSTRACT: *We investigated whether the bodily-mediated production of verbs emerges earlier than verb recognition and oral production during early language acquisition. Children (aged 18–22, 23–27, 28–32, and 33–37 months) viewed animated pictures representing actions related to transitive and intransitive verbs and were asked to (i) orally indicate the verb presented, (ii) recognize the target verb among other verbs, and (iii) perform the actions corresponding to the target verb enunciated by the experimenter. Children 18–22 months showed a capacity to enact the verbs, while their recognition and oral production abilities were not comparably developed. Until 27 months of age, children produced more transitive than intransitive verbs across tasks. The gap between verb recognition and verb oral production was found in all ages tested. This is the first study to directly demonstrate that the ability to produce verbs, especially transitive verbs, via overt body actions emerges ontogenetically earlier than recognition and oral production. © 2013 Wiley Periodicals, Inc.* Dev Psychobiol 56: 510–516, 2014.

Keywords: *language; development; self; cognition; action*

INTRODUCTION

The need to actively engage with the world and other social living creatures is evolutionarily grounded in our mammalian brain. Through body actions and perceptions, the exchanges between emotional urges and external world become effective. In our species, language and high-order cognitive functions represent a fascinating evolutionary achievement that allows human beings to reach and understand the physical and relational world by means of intangible touch, that is, words.

Although the separation of mind and body has been a recurrent theme in philosophical and scientific thinking, recent findings from psychology and neuroscience have demonstrated the connection between language processing and sensory-motor experiences (Varela, Thompson, & Rosch, 1991; Glenberg et al., 2008; Bedny & Caramazza, 2011). Indeed, there has been an impressive consistency among studies on the existence of a common path between body action and language processing, supporting theories on the embodied nature of conceptual knowledge (Rizzolatti & Arbib, 1998; Fischer & Zwaan, 2008; Glenberg & Gallese, 2011). For instance, the exposure to verbs elicits a covert motor simulation of the actions linguistically represented by the verb (Pulvermüller, Härle, & Hummel, 2001). Thus, the cognitive representation of words, perception and action-related processing are inextricably intertwined (Heiser, Iacoboni, Maeda, Marcus, & Mazziotta, 2003; Barsalau, 2008; Fischer & Zwaan, 2008).

The interconnections between linguistic and sensory-motor systems may be traced back to early life. According to classical developmental views, cognitive development is mediated by actions and real-world sensory-motor experiences. By the end of the second year, children mentally represent actions and related possible outcomes by virtue of integration and internalization processes of actual sensorimotor activities

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(Piaget & Inhelder, 1966). Children's development in motor, cognitive, and socio-emotional domains is not disjointed, and the progress in a specific domain is associated with development in other domains (Slobin, Gerhardt, Kyratzis, & Guo, 1996; Jusczyk, 1997). As Maouene, Hidaka, and Smith (2008) have recently shown, there is a positive association between age of acquisition of a verb and proficiency in using the body part involved in the corresponding action. Moreover, developmental language impairments are positively associated with gross motor control deficits (Hill, 2001), and at 21 months, language production is robustly associated with the acquisition of oral motor control capacity (Alcock & Krawczyk, 2010).

Children learn language during daily social exchanges, and young children's language acquisition relies on and is accompanied by progressive understanding of others' intentions, actions, and related linguistic labels (Clark, 2003; Tomasello, 2003). It is noteworthy that during this social-cognitive developmental journey, toddlers show selective observation and overt imitation of others' actions (Carpenter, Akhtar, & Tomasello, 1998; Carpenter, Tomasello, & Striano, 2005; Legerstee & Markova, 2008). Furthermore, understanding of others' intentions and language comprehension develop earlier than language production (Goldin-Meadow, Seligman, & Gelman, 1976).

As in adults, children recruit the brain sensory-motor system during a language comprehension task. Interestingly, however, the adult-like activation of the sensory-motor system during verb processing is stronger when children are allowed to learn new verbs through direct object handling than by mere observation of another person interacting with the objects (James & Swain, 2011).

Taken together, the existing evidence leads naturally into specific questions on relations between conceptual word representations and bodily grounded actions during ontogeny. The time is ripe for examining whether linguistic production of words is built on direct experience and body action production during early language acquisition.

In this framework, the present study is aimed at investigating (i) the developmental course of production of verbs expressed *via* various modalities (i.e., oral production, cognitive recognition, and mere body enacting) and (ii) whether there is a gap in producing transitive and intransitive verbs across modalities.

The transitive and intransitive verbs refer, in fact, to different types of actions on and into the world, respectively. The transitive verbs express a direct and immediate relation between subject, action and object, while the meaning of the intransitive verbs orbits around the relation between subject and action. Thus, it could be easier to understand and learn the changes that imply actions on an external object and the subject as agent – and the related linguistic labels associated with transitive verbs - rather than changes that do not involve the active handling of objects, as expressed through intransitive verbs.

To this end, by adapting a protocol originally developed by our research group (Levi, Capozzi, Parisi, & Rizzo, 1979; Levi, Piredda, & Rocchi, 1989), we designed a 3-task test in which children of four age groups (from 18 to 37 months) were asked to name verbs, to recognize target verbs among other verbs, and to perform the actions corresponding to the verbs mentioned by an experimenter.

We predicted that young children would be able to produce the meaning of verbs initially through body action, then by recognizing and, finally, by orally producing them. In other words, the ability to bodily produce verbs would emerge earlier than verb recognition and oral production. In addition, we expected that children would recognize and produce more transitive than intransitive verbs across modalities, especially at earlier age.

METHODS

Subjects

Subjects were 88 typically-developing children of four age groups: 18-22 months (9 girls, 13 boys; M = 20, SD = 1.4); 23–27 months (8 girls, 14 boys; M = 25, SD = 1.3); 28–32 months (9 girls, 13 boys; M = 30, SD = 1.3); 33–37 months (9 girls, 13 boys; M = 35, SD = 1.3). None of the children included in this study had hearing deficits and delayed motor or language development. All children were monolingual speakers and predominately from middle-income families recruited from public schools in Lazio and Marche areas.

All parents signed informed consent forms. The study was approved by the institutional review board of University of Rome Sapienza.

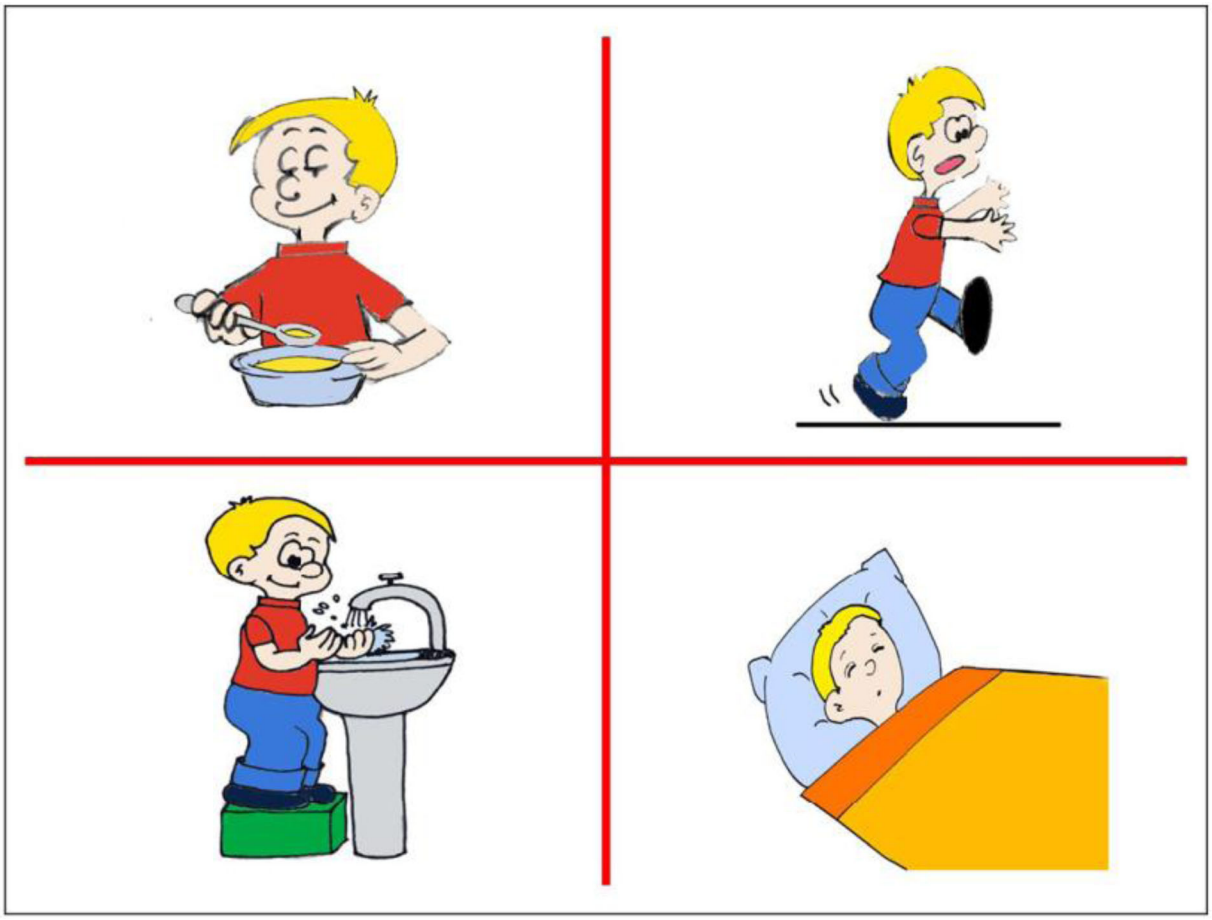
Design and Procedure

A total of 22 verbs were selected from the 'Primo Vocabolario del Bambino' (PVB), the Italian version of the MacArthur-Bates Communicative Development Inventory (Caselli & Casadio, 1995).

The transitive verbs were: *drinking, writing, throwing, eating, giving, taking, calling/making a call, washing, pushing, beating, blowing*. The intransitive verbs were: *sitting, sleeping, crying, getting upset, jumping, falling over, walking, getting on/standing up, getting down, dancing, and running*. These verbs are generally well-known by Italian children aged 33–37 months (Levi et al., 1979).

Twenty-two color animated pictures, each representing a child performing the action associated with a verb, were prepared by a professional cartoonist and used for stimulus presentation (Table 1).

Table 1. Sample of Pictures Representing the Actions



The actual stimulus was a short video-clip.

The stimuli were presented on a 30 × 47 cm computer monitor.

The child had the opportunity to become familiar with the experimenter for about 15 minutes prior to the experiment, and the experimenter was seated next to the child for the duration of the test.

Children were tested individually at their own school. To prevent the child from being distracted by environmental stimuli, all possible sources of distraction (e.g., mirrors, food, and non-experimental toys) were removed from the room.

The test comprised three tasks:

Verb oral production task. This task was aimed at investigating the child's ability to orally produce the verb associated with the action presented."

The twenty-two stimuli were presented one after the other on the computer monitor. Immediately after the presentation of each short cartoon, the child was asked to explain the action presented (the instruction was: "What is the child doing?").

The children's answers were classified as correct or incorrect. The answer was considered correct when the child orally produced the appropriate verb. For instance, after viewing a child eating, the correct answer was "to eat" or "eating", while answers such as "food" or "cooking" were considered incorrect.

Verb recognition task. During this task, we assessed the child's ability to cognitively comprehend and recognize the action congruent with the verb.

The child was presented with four animated pictures simultaneously and was asked to point to the picture matching the verb presented orally by the experimenter (e.g., the instruction was "Tell me, who is eating?").

The answer was considered correct if the child pointed the action associated with the verb.

Verb enacting task. This task was aimed at assessing the child's comprehension of the verb and ability to perform the action corresponding to the verb.

Each child was asked to physically perform the action related to the verb expressed by the experimenter (e.g., "Eat!", "Push!").

During this task, the child was allowed to use toys and ordinary objects provided simultaneously on the table (i.e., a teddy bear, a glass, a dish, a spoon, soap bubbles, a whirligig, a telephone, a dispenser, a sponge, a hammer, a pen, and a sheet of paper).

Child's response was scored as correct only if the action related to the verb was performed at the first attempt and using appropriate tools.

The three tasks were presented in a fixed order to ensure that the verb enacting task involving presentation of toys was always last. Indeed, we presumed that the presentation of toys for the enacting test before the other two tasks would have elicited children's emotional reactivity due to the following deprivation of toys for the verb recognition and production tasks. On the other hand, to obviate a possible learning effect, the order of presentation of the stimuli was counterbalanced across tasks by the use of a Latin square design (Winer, 1971). Of note, children were presented with a large number of verbs during each task, considering toddlers' memory span for words (Blake, Austin, Cannon, Lisus, & Vaughan, 1994). In addition, when the answer was not provided within ~20 seconds after the presentation of the stimulus, the experimenter presented the successive verb without providing positive or negative feedback.

At a result, each child received a score on each task (the maximum score for each task was 22).

Statistical Analysis

We used a repeated measure ANOVA, with task and verb type treated as within-subject factors and age group as a between factor. Since there was no effect of gender ($p > 0.05$), gender was not further considered.

To assess the effects of a time-dependent change in a child's performance during the test, we have divided each task into two blocks consisting of the first and last halves of each series of stimulus presentation, respectively. We performed a repeated measure ANOVA with the blocks of each task as within factors. The analysis indicated that there were no differences between blocks within any task (all $p > 0.1$).

The final analysis focused on a 4 (age: 18–22, 23–27, 28–32 and 33–37 months) × 3 (task: verb oral production, verb recognition, verb enacting) × 2 (verb type: transitive, intransitive) design.

Post-hoc comparisons were performed using Tukey´s HSD test.

RESULTS

We found a significant main effect of age, with older children performing overall better than younger children [age: $F(3,84) = 57$, $p < 0.0001$, $\eta_p^2 = 0.83$, 33–37 age group >28–32 > 23–27 > 18–22 age groups, $p < 0.01$, after post-hoc comparison]. In addition, we found a main effect of task, with children performing better during the verb enacting (M = 8.3; SD = 2.8) than during the verb recognition (M = 7.9; SD = 3.1) and the verb oral production (M = 3.4; SD = 3.1) tasks [task: $F(2,168) = 298$, $p < 0.0001$, $\eta_p 2 = 0.4$, verb enacting > verb recognition > verb oral production, $p < 0.05$ after post-hoc comparison].

The crucial finding emerged on the significant interaction age x task: In children aged 18-22 months, the best performances occurred mainly during the verb enacting task [$F(6,168) = 3.2$, $p = 0.005$, $\eta_p^2 = 0.8$, 18–22 age group: verb enacting > verb recognition> verb oral production, $p < 0.05$ after post-hoc analysis]. In all the other groups, the differences between enacting and recognition tasks disappeared, but the gap between verb oral production and the other two tasks persisted, with lowest scores obtained during the verb oral production task (In the 23–27, 28–32 and 33-37 age groups: verb recognition and verb enacting > verb oral production, $p < 0.05$, after post-hoc analysis, Fig. 1a).

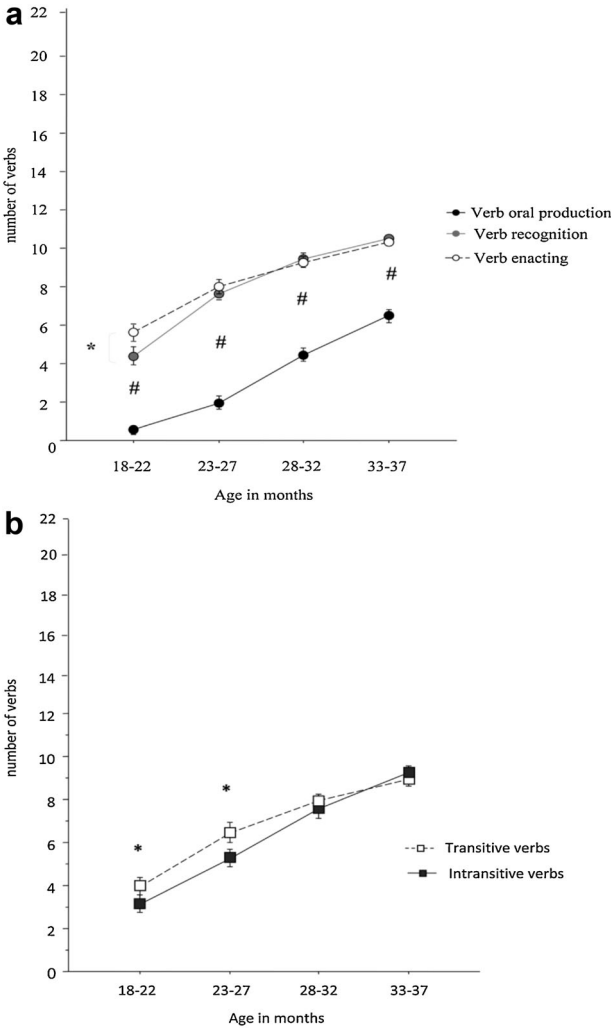


FIGURE 1 (a) Mean ± SE of verbs produced during the 3 tasks (verb oral production, verb recognition, and verb enacting) by the 4 age groups (18–22, 23–27, 28–32, and 33–37 months). * $p < 0.01$ verb enacting task > verb recognition task in younger children (18–22 months); #$p < 0.01$ verb enacting and verb recognition >verb oral production in all age groups, after post-hoc analysis. (b) Mean ± SE of transitive and intransitive verbs produced by the 4 age groups (18–22, 23–27, 28–32, and 33–37 months). * $p < 0.01$ transitive verbs > intransitive verbs in 18–22 and 23–27 month-old children, after post-hoc analysis.

Table 2. Mean (SD) of Transitive and Intransitive Verbs Across the Three Tasks (Verb Oral Production, Verb Recognition, Verb Enacting); ▼p < 0.05, Transitive > Intransitive Verbs During Verb Recognition and Verb Enacting Tasks

	Verb Oral Production	Verb Recognition	Verb Enacting
transitive	3.3 (3)	8.3 (3)▼	8.8 (2.4)▼
intransitive	3.4 (3)	7.7 (3)	7.8 (3)
Factor			
task: $F(2,168) = 298$, $p < 0.0001$			
verb type: $F(1,84)=18.5$, $p < 0.0001$;			
task x verb type: $F(2,168) = 9.2$, $p = 0.0002$			

▼$p < 0.05$, difference between transitive and intransitive verbs.

The transitive verbs (M = 6.8; SD = 3.7) had an advantage over the intransitive (M = 6.2; SD = 3.8) verbs, during the verb enacting and verb recognition tasks [verb type: $F(1,84) = 18.5$, $p < 0.0001$, $\eta_p^2 = 0.8$; task x verb type: $F(2,168) = 9.2$, $p = 0.0002$, $\eta_p^2 = 0.82$, during verb enacting and verb recognition tasks: transitive verbs > intransitive verbs, $p < 0.05$, after post-hoc analysis, Table 2]. Across tasks, the first two age groups (18–22 and 23–27 months) had higher scores on transitive than intransitive verbs [age × verb type: $F(3,84) = 7.4$, $p = 0.0002$, $\eta_p^2 = 0.78$; in 18–22 and 23–27 age groups: transitive verbs >intransitive verbs, $p < 0.05$, after post-hoc analysis, Fig. 1b]. No significant task × age × verb type interaction was found [$F(6,168) = 1$, $p = 0.4$].

DISCUSSION

The present study demonstrates that the ability to bodily produce verbs emerges developmentally earlier than verb recognition and oral production. In particular, young children were able to produce the meaning of verbs by performing the actions corresponding to the verbs, while their abilities to recognize the target verb among other verbs and orally produce them were not comparably developed.

The gap between verb enacting and verb recognition disappeared during the second year of life. On the other hand, oral production ability progressively and robustly increased with age, but not at the levels of verb enacting and verb recognition.

The discrepancy between verb recognition and verb oral production abilities in all age groups is corroborated by previous studies showing that language comprehension develops earlier than verbal production (Goldin-Meadow et al., 1976; Childers & Tomasello, 2002). The later emergence of oral production ability might be due in part to difficulty in planning, controlling, and monitoring the oral articulation of the target verbs while mentally representing the action associated with the verb.

Also, the overall persistence of differences between enacting and oral production abilities in older children offers support to previous studies indicating that children learn new words primarily by performing actions on objects (Huttenlocher, Smiley & Chaney, 1983; James & Swain, 2011).

These findings are in line with previous data showing that early simultaneous use of speech and hand movements is not only associated with language acquisition, but it also predicts later language development (Iverson & Goldin-Meadow, 2005).

Of note, during the verb recognition task, four pictures were presented simultaneously and the child was asked to point the picture that matches with the verb produced by the experimenter. It would be possible to hypothesize that the poorer performance observed during the verb recognition compared to the verb enacting task might be due to an overexposure to animated pictures during the verb recognition task. However, this interpretation seems untenable. During the enacting task, indeed, the children were exposed to more than four objects simultaneously. On the other hand, future studies should focus the observations to toddlers aged 18–22 months and address whether there is a subtle developmental gap between explicit and implicit verb recognition (e.g., pointing *versus* time spent looking at the correct answer).

Moreover, as future studies using a between-subject design might confirm and extend our observations, the improved performance over the three tasks seems unlikely to be due to an order of presentation or priming effect. Indeed, no time-dependent differences were found comparing the scores on the first and last halves of each series of stimuli within each task. Presumably, the opportunity to become familiar with the experimenter prior to the experiment, in conjunc-

tion with the lack of feedback during the tasks, contributed to limiting possible learning effects during the experiment.

Consistent with classical developmental theories and recent views of embodied language acquisition (Piaget & Inhelder, 1966; Fischer & Zwaan, 2008; Glenberg & Gallese, 2011), our findings clearly demonstrate that verb acquisition is developmentally grounded on body actions in young children. Thus, it is not surprising that children were able to learn transitive verbs earlier than intransitive verbs. Transitive verbs dominated during the second year, when children were already able to enact and recognize the verbs at comparable levels.

Our results indicating that transitive verbs are acquired earlier than intransitive verbs are in line with previous findings showing an advantage of transitive verbs over intransitive ones (Davidoff & Masterson, 1986; but see Fenson et al., 1992, for advantage of intransitive leg-related over transitive hand-related verbs).

From a developmental perspective, it is reasonable to speculate that for a young child, language acquisition is associated with the rewarding feeling of personal agency. As the transitive verbs are associated with the notion of causativity and the self as author of the action, children initially learn the transitive verbs by performing actions on objects with the self as agent and, then, the intransitive verbs by acting into the real world, i.e., without necessarily applying transformations on external objects. Thus, the advantage of transitive verbs over the intransitive verbs is, presumably, facilitates by the use of self-directed tools (McCarty, Clifton, & Collard, 2001). As demonstrated by Brooks, Tomasello, Dodson, and Lewis (1999), young children indeed show a bias for the use of transitive verbs to describe actions. Interestingly, preschool children not only tend to learn transitive verbs earlier than intransitive ones, but they also tend to apply a transitive construction when using new intransitive verbs (Baker, 1979; Braine & Brooks, 1995).

Concurrently with the development of oral production ability, the advantage of transitive over intransitive verbs is reduced. Indeed, we have found that the advantage of transitive verbs across tasks disappears in the oldest age groups. The progressive developmental alignment between enacting and recognition capacities, followed by an alignment of the abilities to master transitive and intransitive verbs, seems evocative of a progressive development of cognitive representational abilities and regulation of overt body actions.

The result showing that the difference between enacting and recognition abilities disappears during the second year of life is quite intriguing. This age is, in fact, a critical period for language acquisition and for the manifestation of possible language impairments. Children's ability to perform intentional actions is associated with their ability to perform cognitive and linguistic representations of their own and others' actions. Thus, future studies might focus specifically on the interplay between mental motor imagery, which implies the covert activation of the sensory-motor system and related representation of actions, and language acquisition during this delicate developmental window. These findings would shed new light on covert action simulation processes (Fischer & Zwaan, 2008) and Piaget's hypothesis that forms of mental imagery emerge during the second year of life (Piaget & Inhelder, 1966).

We found no significant differences between boys and girls. This finding seems surprising considering that sex differences in language acquisition are well-known (Maccoby, 1996). However, the limited number of girls tested in the present study might, in part, account for the lack of sex differences.

Our findings have strong practical implications. It is noteworthy that possible language disorders are usually assessed by contrasting the performances in cognitive comprehension and oral production. However, our study stresses the importance of including an enacting task in the protocol for the assessment of children's language disorders, since the initial productions of verbs is *via* body actions. The understanding of early balance between verb enacting, verb recognition and verb oral production performances would be informative of the child's early cognitive-communicative abilities. It is also conceivable that the early ability to enact verbs would predict later performances in recognition and oral production abilities. Thus, future studies should address this question by adopting a longitudinal approach. In this scenario, early diagnosis and intervention for potential language impairments could be undertaken during the "prelinguistic" period.

NOTES

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