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Olga Peralta [a], Analía Salsa [a], María del Rosario Maita [a] & Florencia Mareovich [a]

[a] National Research Council CONICET, Instituto Rosario de Investigaciones en Ciencias de la Educación, IRICE, Rosario, Argentina

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Scaffolding young children's understanding of symbolic objects

Olga Peralta*, Analía Salsa, María del Rosario Maita and Florencia Mareovich

National Research Council CONICET, Instituto Rosario de Investigaciones en Ciencias de la Educación, IRICE, Rosario, Argentina

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Symbolic objects are cognitive tools children must learn to master very early in life. A crucial factor in cognitive development is the instruction or informational support children receive in social contexts. While numerous studies have investigated the relation between instruction and development in various domains, like language or symbolic play, still little is known concerning the role of this factor in the comprehension of symbolic objects. The purpose of this article is to illustrate with an overview of the results of the authors' research how instruction scaffolds the comprehension and use of symbolic objects. In this framework instruction is conceived as a process that mediates the skills that children develop and meanings they build. Some educational implications are discussed.

Keywords: symbolic objects; symbolic comprehension; scaffolding; instruction

During the first years of life, children begin to master symbolic systems and objects necessary for full participation in the culture (such as letters, numbers, graphs). According to Vygotsky (1978), symbols serve as cognitive tools that expand and extend thought and knowledge, providing experiences concerning facts and entities to which we do not have direct access, and this widens our learning opportunities.

Symbolic objects, such as pictures, scale-models and maps, are physical objects and, at the same time, symbols of the entities they represent. Understanding the representational character of these objects constitutes a real challenge for young children, a challenge that stems precisely from their *double nature* as children have difficulties considering both at the same time, the object itself and its abstract relation to what it stands for (DeLoache 1987; Sigel 1978). This understanding of the double reality of a symbolic object depends on the interplay of various factors such as age, experience with symbols and instruction; it also depends on the characteristics of the symbolic object itself, such as iconicity or similarity with the referent or its two- or three-dimensionality (DeLoache 1995). The interplay of these multiple factors affects symbolic awareness (DeLoache, Peralta, and Anderson 1999).

Like all symbols, some symbolic objects, such as photographs or figurative designs, are highly iconic and have a great correspondence between their elements and those of their real counterparts; while others, such as abstract art or statistical graphs, are much more arbitrary. In this sense, symbols have been defined as those entities that someone proposes to represent something different (DeLoache 2004).

*Corresponding author. Email: peralta@irice-conicet.gov.ar

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Human intention, then, is a necessary and sufficient condition for an entity to become a symbol. Therefore, in addition to its representative dimension, symbols have an intentional social dimension that must be perceived for their conventional use (Tomasello 1999).

One of the crucial factors in children's symbolic understanding is the nature and extent of the instruction or informational support they receive in interactive social contexts. As Vygotsky (1978, 2004) pointed out, social factors play a crucial role in the acquisition of symbolic tools. The sociocultural context provides the tools themselves, and social interactions with more experienced partners provide children with opportunities to learn how to use them.

The purpose of this article is precisely to illustrate how adult instruction scaffolds the comprehension and use of symbolic objects. We intend to do so by presenting an overview of our research concerning the role of instruction in the comprehension of symbolic objects. In this framework, instruction is conceived as a process that mediates the skills that children develop and the meanings they build.

For the last few years, my colleagues and I have been systematically studying the impact of adult instruction on young children's understanding of symbolic objects. We conceive *instruction* as the amount and kind of informational support given by a more skilled partner that mediates and scaffolds children's comprehension and use of a symbolic object. Although numerous studies have investigated the relation between adult instruction and development in various domains, such as language or symbolic play, still little is known concerning the role of this factor in the comprehension of symbolic objects.

In order to study the role of instruction in young children's understanding of symbolic objects we used different versions of DeLoache's search task (1987, 1995). In the original version of this task, the information concerning the location of a toy hidden in a full-sized room was provided by a scale model of the room (linear size difference 1:16). In this task the experimenter hides a toy in a specific location in the room (the child does not observe the event), then she hides a smaller replica of the toy in the scale model (the child observes the event) and asks the child to go and find the bigger toy in the full-sized room. In order for the child to be able to use the information provided by the scale model to solve the task, he or she has to form a mental representation of the room based on the information provided by the scale model. That is, the child has to understand the dual nature of the model to be able to 'see' through it towards its referent, the room. If the child does not understand that the model is a symbol for the room, he/she will not be able to use the information provided by the model as a source of information to find the larger toy in the larger room. It has also been pointed out that dual representation is aided by language. Studies using drawings (Callaghan 2000) and scale models (Homer and Nelson 2009) have shown that when children know the name of the objects represented, they can connect the linguistic representation with the referent which, in turn, facilitates symbolic comprehension.

In most of the studies using search tasks, not only with scale models but with other symbolic objects as well, full orientation and instructions were given to the child before the task started concerning *symbol–referent correspondences* and the *intended function of the symbol*. Symbol–referent correspondences refer to equivalences between the items in both spaces and the parallel events that take place in them, while the intended function refers to the experimenter's purpose concerning the function of the symbolic object in the task, to be a source of information to find

the toy. Therefore, an important part of children's understanding of the symbol–referent relation includes some recognition of the adult's intention in using the object as a source of information. The aim of most of these studies was to find out developmental differences in young children's achievement of a representational insight.

The main focus of our studies was to investigate the role of adult instruction in the achievement of this representational insight. We used small rooms (95 cm width x 80 cm depth x 65 cm height) as hiding spaces and the information concerning the localization of the hidden toy was provided either by a similar scale model of the room, a photograph, or a simple black-and-white map. All tasks consisted of six trials in which the toy was hidden each time in a different location. Depending on the study, instructions were varied concerning the *amount of information* provided (full and no instruction), the *type of information* (intentionality, correspondence), and the nature of *direct teaching* (full instruction + feedback).

How much information?

The primary interest of this series of studies (Peralta and Salsa 2003, 2004) was to investigate the impact of the amount of instruction (*complete instruction – no instruction*) on young children's understanding of the symbolic function of an object. The children were 30 and 36 months old. We also wanted to find out if there were learning and transfer effects from full instruction to no instruction.

The studies were conducted using an object retrieval task and two similar-scale spaces (linear size difference approximately 1:2): a small-scale model (50 cm width x 45 cm depth x 35 cm height) and a larger space approximately twice as large. Both were constructed of opaque white fabric supported by a framework of plastic pipes, with the front open so the contents were accessible to the child. Each contained several items of furniture scaled to the size of the spaces: an armchair, a dresser, two floor pillows, a basket, a table covered with a tablecloth and a plant. In each space, in one of the pieces of fabric, there was a small window with a curtain. The physical appearance (shape, color, fabric) of the pieces of furniture was highly similar and they were in the same spatial arrangement. Both spaces were placed on the floor in the same spatial orientation approximately 1 m apart. A room-divider separated them so the child could not view the interiors simultaneously. The hidden objects were two plastic toy children (2 cm and 6 cm high).

At the beginning of the task, children were given either *no instruction* at all or *complete instruction*. The children in the no instruction group were just invited to play a hide-and-seek game in which the experimenter hid the toy in the small space and the child had to find the larger toy in the larger space; no orientation or information was provided. Complete instruction consisted in orientation and full information before the task started concerning the symbol–object correspondences, the parallel events that were going to take place in both spaces and the intended function of the scale model in the task: to be a source of information to find the toy.

The results showed that 36-month-old children did not need any instructional support in order to succeed. On the other hand, the omission of full instructions seriously disrupted 30-month-old children's performance.

However, learning effects were also clearly established in a two-day experiment. On the first day, we gave the 30-month-olds complete instructions; on the second day we gave them no instruction. We found that the 30-month-olds realized that a similar-scale model was related to the space it represented if the relation was fully

explained and demonstrated on the first day and were able to transfer this awareness to a no-instructions task in which they would otherwise inexorably fail.

In addition, and in combination with prior research, this series of studies showed that instruction acts in concert with size similarity. Size similarity has been described as a factor that benefits symbolic comprehension (DeLoache, Kolstad, and Anderson, 1991). When the scale model had a dissimilar scale compared with the referent (1:16), DeLoache Peralta and Anderson (1999) found that spontaneous symbolic comprehension was not attained prior to five and even seven years of age. In contrast, when the scale is similar (1:2), we found 36-month-old children to be quite successful, realizing the symbolic function of the scale model completely on their own.

What kind of instruction?

In a series of studies using photographs we investigated not only the extent but also the nature of the informational support that enables young children to understand an object as a symbol (Salsa and Peralta 2005, 2007; Peralta and Salsa 2011). We used a small space (95 x 80 x 65 cm) and a set of six color photographs (10 x 15 cm) in plastic frames. The space was furnished with a bed, a closet, a plant, floor pillows, a basket, a chest, and a drawer. Each photograph depicted one of the hiding places (pieces of furniture) in the room; all of them showed a frontal view of the object depicted. The object that was hidden during the experimental trials was a plastic toy (6 cm high). A room-divider separated the room from a low table on which the pictures were displayed; the child could not view the room and the photographs simultaneously.

Experiments were conducted using an object-retrieval task in which we varied not only the amount but also the kind of information provided to 30-month-old children. Concerning the amount of information, as with the scale model, it was varied between *complete* and *no instruction*. Complete instruction consisted in giving full information concerning picture–object correspondences and the intended function of the symbol in the task. In the no-instruction condition, we simply presented the task as a hide-and-seek game and invited the child to play. As far as the kind of information is concerned, it was varied by either stressing picture–object *correspondences* or the *intended function* of the photographs in the task. In the first instance, we gave exhaustive information concerning one-to-one picture–object correspondences; in the second, we particularly stressed the function of the pictures as sources of useful information in order to find the toy in the room.

In concordance with previous research, we found that 30-month-old children succeed with complete instruction (DeLoache and Burns 1994), but they failed when no instruction was provided. As far as the kind of informational support is concerned, the information that emphasized intentionality was critical and children performed the task at the same level as with full instruction. Concerning picture–object correspondences, although this kind of information was not enough in itself, children came to achieve an insight halfway through the six trials, probably as a consequence of a comparison process. That is, after failing the first three trials, most children in the comparison group succeeded in the last three. This observation is in line with results reported in analogical reasoning research (e.g. Gentner and Markman 1997; Gentner and Namy 1999; Lowenstein and Gentner 2001), which proposes that the comparison process involving structural alignment and one-to-one

mapping eventually provides deeper cognitive insights. On the other hand, when children were given information only about the intended function of the pictures in the task, they were highly successful from the very beginning.

Our studies suggest, then, that highlighting the heart of the symbolic relation – its intended function (Bloom and Markson 1998; Callaghan and Rankin 2002; DeLoache 2004; Tomasello 1999) – is a privileged route towards children's appreciation of a symbol–referent relation.

We also tested when children would not need any instruction at all to figure out the symbolic nature of the pictures in the task. We found that six months later, by 36 months of age, children spontaneously used the photographs to solve the task.

How about teaching?

Is it possible to teach the symbolic function of an object to very young children? This was the main question we addressed in a series of studies (Maita and Peralta 2010, 2012). The studies employed a task in which children had to use a very simple black-and-white map in order to find a toy hidden in a small space (95 x 80 x 80 cm). The space resembled a bedroom; its front was opened so the contents were accessible to the child. It contained several items of furniture: a bed, a box, a closet, a basket, a night table, and a floor pillow. The map (21 x 29 cm) consisted of an aerial view of the space from above, which only represented the external shape of the real objects with a black line; no volume was represented and no color was used. The outline shapes were drawn to scale, maintaining the same spatial arrangement as the objects in the room.

Teaching meant much more than providing full orientation and instruction at the beginning of the task. It meant that when children failed in the first search or did not know what to do, the experimenter corrected them and showed them the right location. She took the toy out of its hiding place in front of the child, explaining symbol–object correspondences again and highlighting the intended function of the map in the task. Therefore, teaching consisted in full orientation and instruction before the task began, plus corrective feedback and modeling during the task after the first failed search. We reasoned that in everyday social interactions when adults instruct young children they use explanations, contingent information and feedback; all these constitute powerful natural mechanisms in the transmission of knowledge and skills (Csbira and Gergely 2009, 2011; Tomasello 1999).

We started exploring at what age children would understand the representational function of the map without any instruction at all. Results showed that 36-month-old children did not comprehend the relation on their own; at 42 months of age, half of them did and half did not; it was only from 46 months of age that most children spontaneously comprehended the map–room relation with no instruction.

The next question was: Is it possible to teach the symbolic function of a map to very young children? To answer this question we tested three groups of 36-month-old children in three conditions: *no instruction*, *complete instruction* at the beginning of the task (map–space correspondence and intended function), and *teaching* (full instructions plus feedback). Results showed that 36-month-olds succeeded in using the map symbolically only after failing the first search and being explicitly taught.

Surprisingly, we also found that the performance of the complete-instruction group was very similar to that of the no-instruction group (Maita, Mareovich and

Peralta, submitted). How did this teaching work? Why did children who were corrected gain a representational insight while those who received complete instruction at the beginning of the task did not? We considered that the information and feedback contingent to the child's search was the key factor that allowed the child to infer the communicative intention of the experimenter and benefit from her instruction. Thus, the feedback and demonstration the experimenter provided invited the child to 'read' the scenario as a pedagogic situation (O'Doherty et al. 2011). The fact that this demonstration was *after* the child failed probably contributed to interpreting the situation as a teaching one (Csibra and Gergely 2011) and not only as a situation in which the child had to solve a task alone (not knowing exactly what to do). Thus, the teaching group engaged in a communicative interaction and benefited from it, while the instruction group did not.

We conclude, then, that it is possible to teach the symbolic function of an object. Also, and at least in the case of this particular map, complete instruction proved not to be enough: what children needed was explicit teaching and corrective, contingent feedback.

We then wondered if it was possible to teach the symbolic function of the map to even younger children, to 30-month-olds. We found that six months younger children did not comprehend the symbolic function of the map in spite of all the instruction, correction and feedback received. This research shows that adult teaching and corrective feedback are crucial for symbolic understanding at some points in development.

Conclusions

As has been clearly documented by the literature in the field, the ability to use symbolic artifacts improves with age and cognitive changes contribute to this development. However, the achievement of a representational insight depends not only on developmental processes related to maturation and age; interaction with a more experienced partner, who is familiar with the use of the tool, also has an impact. When the comprehension of a symbolic tool is undergoing change and children have a certain degree of cognitive flexibility, adult input may trigger symbolic development. Symbolic development is rooted in several factors: some, like perceptual, cognitive and action mechanisms, are brought by the child while others, like the experience with symbolic objects and the informational support provided, come from the social context. In this sense, Callaghan and Rankin (2002) stated that symbolic understanding is founded in perceptual differentiation, perceptual categorization and analogical reasoning, as well as in learning. One source of learning is observation; another is instruction as adults typically instruct children how to engage in particular behaviors in communicative and referential contexts.

Numerous studies of children's cognition have been centered on identifying early cognitive competences and explicating the maturational bases of children's thinking. Yet, the issues of how young children come to achieve these feats and how their thinking is shaped by learning and experience are much less explored. The studies discussed show that, for the acquisition of the comprehension and use of symbolic objects by very young children, the scaffolding that adult instruction provides is crucial at some points in development.

As Tomasello pointed out (2000, 2002, 2008), humans learn not only *from* but also *through* another person. The understanding of others as intentional beings is

crucial in human learning since the social practices and cultural tools invariably represent the communicative situations for which they were designed. According to Csibra and Gergely (2009, 2011), this transmission of cultural knowledge between individuals constitutes a system of *natural pedagogy* in which experts transmit to novices a variety of different types of cultural knowledge, including the understanding and use of arbitrary referential symbols.

Nelson (1996, 2010) conceived the development of the mind as a collaborative construction that retains and integrates both individuality and social convention. She proposed that children's acquisition of knowledge and skills is a result of a convergent process in which individual activity is as crucial as the interaction with the cultural, social and linguistic world where adults engage as mediators of children's cognitive processes. The result is a 'hybrid mind' (Donald 1991), which retains its basis in individual experience, but learns new things through participation in culture and in the use of representational systems.

In this sense, this article is intended to illustrate ways in which cognition is interwoven in social interaction and individual activity. We have tried to do this by exemplifying the role that instruction plays in the development of the human mind, specifically in the understanding and use of symbolic objects.

The studies discussed may also have educational implications. As has been stated (e.g. Uttal, Liu, and DeLoache 2006; Uttal, et al. 2009) in any instructional use of symbolic representations, one cannot assume that children will independently appreciate any given symbol–referent relation (e.g. book illustrations, videos, manipulatives). Novices in any symbolic medium may need explicit tuition in order to master it. Explicit tuition means building a scaffolding (Wood, Bruner and Ross 1976) to guide children's actions, managing and regulating factors which may interfere or benefit symbolic comprehension and use.

In summary, the research discussed provides evidence that the detection of the symbolic function of an object can be mediated and that there are moments in symbolic development at which children are sensitive to the scaffolding provided by an adult. Guidance from more experienced social partners plays a critical role concerning when and how children begin to understand a symbolic artifact and learn how to use it. The research discussed shows ways in which social interaction may help children learn about symbolic tools that aid thinking. This mediation awakens cognitive processes revealing the subtle interplay between learning and development proposed long ago by Vygotsky (1978).

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