Chapter 2

What Drives Symbolic Development? The Case of Pictorial Comprehension and Production

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> *The innateness of the longing for relation is apparent even in the earliest and dimmest age.* —Martin Buber (1970, p. 77)

How do children become symbol minded? The literature dealing with this question is abundant in relation to language, but sparse in the pictorial domain. We still know relatively little as to how children come to understand pictures as symbolic re-presentations. How do children come to produce and understand pictures as a special class of two-dimensional objects that stand for other things? How do they develop the ability to use and comprehend pictures as sources of knowledge about the self, objects, and people?

One possible reason why the origins of symbolic development remain relatively elusive in the domain of pictorial production and comprehension is due to the fact that pictures are particularly complex symbol systems. Following the dictum that pictures are worth a thousand words, pictures typically contain multiple layers of meaning that *co-exist simultaneously* on the two dimensional support, whether it is a piece of paper, a canvas, or a flat screen. All these layers are typically presented at once, and contrary to language or even play, the meaning

of pictures does not unfold over time according to precise conventions and ready made syntactic rules.

The "double noose" picture presented in Figure 2.1 is a case in point. Created by a group of Atlanta artists, this image is intended to trigger an intense process of meaning-making via unease and vexation in the viewer. A noose is a well-known artifact with strong political connotations in the Southern United States where it is readily associated with lynching and other forms of racial violence against Black people. It is a politically loaded symbol. The doubling of the noose brings about yet another, more encompassing meaning. It stands for infinity as the conventional configuration of the infinity sign. By doubling the noose, the intention of the artists was to elevate its meaning above American reality, to symbolize violence as a process that endlessly feeds into itself; an absurd, vicious circle. Their goal thus was to offer to the public a powerful image as a tool for reflection on how to break this cycle, and ultimately for this image to become the universal symbol of a desire for peace and reconciliation. Via bumper stickers and other public billboards, it is a call and a deliberate piece of propaganda for breaking the cycle of violence. Pictures are indeed worth a thousand words.

Language and play may also dominate the symbolic development literature because they are manifested earlier in development. Infants babble and engage in dyadic play long before they draw or look at picture books. This precedence places language and play as the potential precursors of pictorial competencies, notwithstanding a marked difference in sensorimotor skill demands placed on the production of pictures as compared to speech.

Finally, another reason why language and play appear to dominate the symbolic development literature, is that pictures, at least those that infants and children look at, tend to be less arbitrary, typically mirroring and re-creating the visual experience of the world on a 2D surface. As Gibson (1971) pointed out, realistic pictures tend to reproduce the information used in the perception of the real world. This makes the arguments for the necessity of higher mental processes and representation less compelling as compared to the language domain. Language is indeed inseparable from the requirements of a complex, rule-based representational system articulating a finite number of arbitrary signs. Thus, at

FIG. 2.1. The "double noose" image as illustration of pictorial complexity and the co-existing layers of meaning in static pictorial representations. *The Infinity Project* (2002), Atlanta, GA (reproduced with permission).

first glance, language acquisition seems to represent a greater developmental feat for the child, making it more interesting to researchers. The interpretative complexity of the "double noose" image discussed earlier demonstrates how slim the ground is for such a rationale. Like poetry, pictures can contain subtle meanings that require aesthetic intuitions and emotional capacities, in addition to representational (symbolic) abilities. But how do children acquire these abilities, and more importantly, by which mechanisms?

The goal of this chapter is to present ideas as to how children become symbolic in dealing with pictures. As a general background, we propose that the development of pictorial production and understanding arises first and foremost in the context of a need to communicate and maintain social proximity with others (*"basic affiliative need"* or "BAN": the avoidance at all cost of being socially isolated or separated from others). We propose here that construing symbolic development in these social/relational terms helps to account for not only *what* develops when symbolic activities and symbolic skills develop (the process of how symbolic development comes about), but also, and probably more importantly, what might be some of the mechanisms or *causes* that drive symbolic development. To a large extent, this latter question remains open, with the majority of research to date being limited to the description of how symbolic development unfolds, not why.

This chapter is organized as follows: First we emphasize the fact that pictorial symbols, like any other symbols, are by definition communicative and intentional. Symbols are deliberately created to communicate, hence to be intelligible by others. Their function is to capture and eventually influence the mind of others (see the example of Figure 2.1). We then outline a model that articulates six levels of basic meaning contained in pictures. This model is informed by existing developmental research on how children might develop their construal of pictures as symbols, between birth and approximately 5 years of age. We then turn to what might drive children toward their symbolic understanding of pictures. We posit that at the core there is a general propensity to reproduce actions and their consequences. In the social realm, infants from birth are actively relating to others via imitation. Imitation is the general propensity to reproduce actions and attitudes perceived in others, and it is a primary mechanism of the social affiliation that also drives symbolic development. We identify at least three forms of reproductive propensities that unfold chronologically in development between birth and the end of the second year. Finally, based on recent research, we review evidence supporting our theoretical propositions. In particular, we present research demonstrating that what contributes most to symbolic development, and in particular to the construal of pictures as symbols, are *social factors*. A first study shows that the contemplative stance attached to pictorial artifacts is first emulated by infants watching adults interacting with such artifacts. A second study shows that children eventually develop their pictorial understanding to include the characteristics of the picture maker via a

process of simulation. We show that this development is linked to the development of theories of mind. In a third study we present data that point unambiguously to the role of adult scaffolding in the development of graphic symbols production and comprehension. We conclude that what is reported here is not exclusive to the development of pictorial production and understanding, and might apply to symbolic development in general.

PICTURES AS INTENTIONAL SYMBOLIC ARTIFACTS

Pictorial symbols form a special class of artifacts that are communicative in their function and deliberate in their making. Graphic symbols are intentional representations, not accidental things that resemble other things. The intentional nature of symbols needs to be acknowledged from the start to avoid confusion and to emphasize the primary *social* and *communicative* nature of symbols in general (see Goodman, 1968; Wittgenstein, 1953). Let us consider a child contemplating clouds in the sky and pointing to a configuration that looks like a rabbit. "Look, a rabbit in the sky!" says the child. The child is clearly referential and symbolic in his explicit observation and deictic gesture, but the cloud in *itself* is not, as it just happened to be there, randomly floating in the sky. In this instance, the rabbit cloud is not a graphic symbol per se, just an accidental configuration resembling something else, the analogy picked up by the child. Let us suppose now that the child points to a rabbit configuration in the sky that happened to have been sky drawn by a small plane puffing steam. The rabbit cloud configuration then becomes symbolic in nature (see Figure 2.2). The child picks up on something that is deliberately created by someone else (the pilot of the small plane) with the intention of depicting or representing an exemplar of a specific kind of thing (rabbit). The rabbit cloud becomes a symbol because it originates from a deliberate creation and is caused by an agent who intends to communicate to who ever looks up in the sky.

Thus, pictures as symbols encompass both the comprehension of messages communicated by others to the self, and the intentional production of messages to be delivered to others. In any form of symbolic communication, whether it is a picture or a paragraph, the person delivering the message holds the intended recipient in mind as they formulate the message, adjusting and fine tuning nuances of the final form depending on how he or she intends to influence the recipient. Likewise, the person receiving the message holds in mind the producer of the message, mining the message for the precise meaning that was intended for them. Communicative intentions are conveyed in the act of creating the symbol, and understood in the act of reading the symbol. It should be noted that symbol creators, whether photographers or sky drawing pilots, may intend their symbolic representation to hold many potential layers of meaning. The viewers,

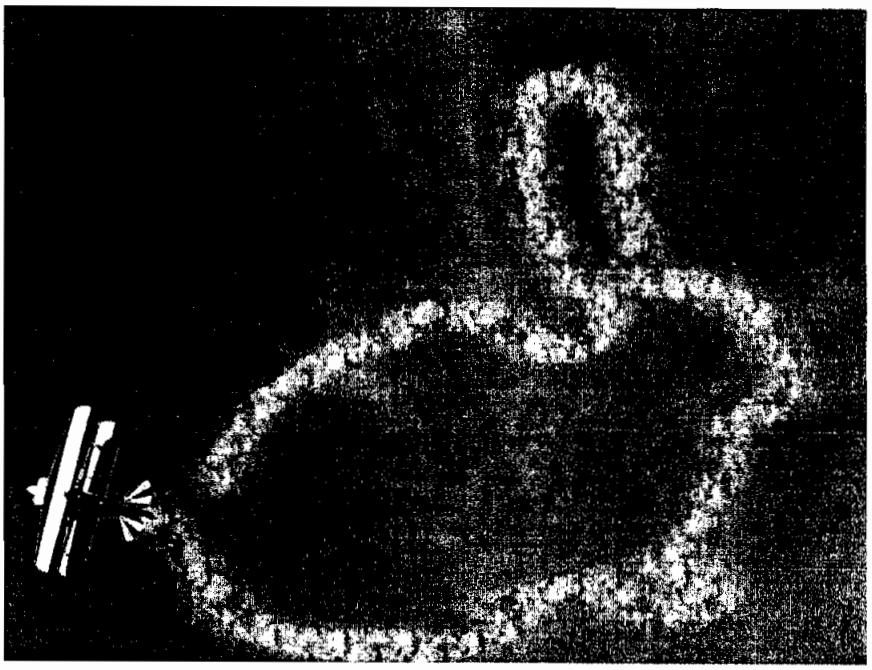

FIG. 2.2. The airplane's drawing of a rabbit in the sky by an intentional pilot makes it a symbol. In contrast, a cloud sharing by accident the surface structure of something that looks like a rabbit is not a symbol. It is merely a morphologically rabbit-resembling mark in the sky.

in unpacking that meaning, must appreciate the visual product in light of the intentions directed toward them by the person(s) who created the graphic symbol.

Freeman (1995) articulated the complexity of picture symbol understanding by proposing that mature picture reasoning rests on an appreciation of the intentional network between pictures and the referent world, the artist, and the viewer. Along the lines of Wolheim's original ideas (Wolheim,1993), Freeman suggests that children would begin to construct meaning following an earlier phase where there is a strict reliance on relating properties of the picture to properties of the real world. They then progressively would shift toward an appreciation of the intentional relation between pictures, artists, and viewers. Accordingly, pictorial reasoning develops to include theorizing about others' minds, with children developing an increasingly mentalistic stance toward pictures (Freeman, 1995). Our recent research provides empirical support for this development (Callaghan & Rochat, in press; see description of the experiment and findings below). However, questions remain as to the finer details and driving force behind such development. We present next a model of this development seen as the construction of six levels of pictorial meaning that emerge chronologically between birth and approximately 4 years of age.

SIX-LEVEL MODEL OF PICTORIAL MEANING AND REASONING

We started this chapter by stating that pictures typically contain multiple layers of meaning that co-exist simultaneously and that are partially or fully picked up by the viewer. A formal account of these layers of meaning, albeit difficult, can be achieved by considering how infants and children develop their responses to graphic symbols. Developmental research on young children's comprehension and production of pictures points to six basic levels of pictorial meaning and reasoning. The taxonomy of these levels is informed by existing developmental research and represents basic levels of pictorial meaning making and reasoning. We propose that it also represents basic levels of pictorial meaning making even after this development is achieved. In other words, we suggest that once developed, these basic levels would constitute the range of possible levels at which individuals operate to make sense of pictures, independent of age but dependent on the nature of the symbol itself as well as on social and cultural factors. Beyond the age of approximately 4 years, making sense of pictures would depend primarily on experience with pictorial symbols, particularly social exposure to symbolic artifacts.

Thus, pictorial meaning making of children 4 years and older, corresponds to one of these six levels, depending on the state and circumstances of the individual encountering graphic symbols: for example, whether staring at a colorful cereal box while still partially asleep, engrossed in reading a suspenseful comic strip, or in solemn contemplation of a painting in a museum. As adults, our awareness of pictures constantly oscillates between these basic levels of pictorial awareness. We describe these levels next, in the order of their developmental unfolding. Note, however, that although the sequencing of the levels follows a progression that is both logical and supported by research, the age at which the viewer expresses a particular level of understanding varies depending on many factors, in particular the relative experience with the medium. As a case in point, when presented with a challenging picture, such as the double noose of Figure 2.1, only a few adults may be able to access all levels of intended meaning without some additional information regarding the creator's intention.

Level 0

Level 0 expresses the absence of any differentiation between a symbol and its referent. We label this initial state "0" to connote this absence. In development, this differentiation is not a given and research suggests that at some point in early development, infants seem to confound pictures and their referents, as if pictures were mere extensions of the environmental layout surrounding the viewer. So, in our model, *Level 0* of pictorial awareness corresponds to the absence of any differentiation between the pictorial symbol and its referent.

Research on the development of pictorial comprehension suggests that infants at an early stage tend to confuse picture with referent. For example, infants less than 9 months have been reported to physically grasp objects depicted in high quality photographs or attempt to put a 2D depicted shoe on their foot (DeLoache, Pierroutsakos, Uttal, Rosengren, & Gottlieb,1998; Perner, 1991). With these behaviors, infants seem to confound reality with its representation, thus lacking the basic differentiation of action affordances allowing pictures to enter the mind as a special class of referential or representational objects. Note that sophisticated adult artifacts play on this level of pictorial awareness, namely its basic absence, in "trompe l'oeil" paintings which are meant to mask the differentiation between the 3D environment and the 2D representation of it. The representational nature of pictures is also suspended when older children or adults are so captivated by a movie that they somehow abandon themselves to the phenomenal experience so that the screen becomes more than a mere 2D depiction of reality; it becomes reality itself. There are indeed many instances when even adults dwell in a temporary lack of differentiation between depicting and depicted, often paying money to experience this lack of awareness. Infants, up to their first birthday, seem to be naturally inclined to express the basic lack of pictorial awareness characterizing *Level 0.* However, as we see next, this inclination is not the only characteristic of pictorial awareness at the beginning of life. Although they might try to grasp objects depicted in photographs, young infants demonstrate also that they are capable of perceptually differentiating objects existing in the environment from their 2D representation in photographs or drawings. We will show that early in development, *Level 0* of picture comprehension depends on situational demands and social factors (Callaghan, Rochat, MacGillivray, & MacLellan, 2003).

In relation to the production of graphic symbols, *Level 0* corresponds to the period in infancy, from the time infants are capable of coordinating eyes and hands in reaching and grasping (approximately 4 months) to the time when the activity of leaving traces on a 2D surface holds no other status than the pleasure of a newly discovered sensorimotor activity. In the first year of life, there is no indication that the infant intends to depict forms in their scribbling on papers or in the leaving of traces of their action on other 2D surfaces (Golomb,1992; Matthews, 1984; Winner, 1982). There are anecdotal reports that in their first year infants might sometimes move the pencil in a way to represent the referent, bouncing, for example, the pencil across the page to represent a rabbit hopping (Matthews, 1984). This kind of behavior indicates primarily that infants confuse symbol and referent in their graphic production, expressing *Level 0* of pictorial awareness.

Level 1

Level 1 of pictorial awareness corresponds to the expression of a basic differentiation between 2D depicting artifacts and the depicted 3D reality. This is the basic level at which symbols and their referents are perceptually differentiated. Infancy research suggests this primary level of pictorial understanding is present remarkably early in life. Habituation and visual preference studies show that newborns and infants less than 7 months perceive and discriminate pictures as distinct from the 3D objects they depict (Callaghan et al., 2003; DeLoache, Strauss, & Maynard, 1979; Dirks & Gibson, 1977; Rose, 1977; Slater, Rose, & Morison, 1984). Evidence of such early perceptual differentiation indicate that the expression of the confusion of *Level 0* may not be due to a lack of perceptual ability per se, but rather may depend (among other things) on relative experience and exposure to pictorial artifacts.

In relation to the development of graphic production, at *Level 1* infants add to the mere sensorimotor enjoyment of scribbling by beginning to mark nuances in their drawings. The drawing tool (brush, pen, or crayon) changes status, from being a mere extension of the limb to becoming an object of visual-haptic control (Cox, 1992; Piaget, 1954). This is not yet a symbolic activity per se, but the act of drawing becomes an act that is now differentiated from mere action of the limb with contingent visual consequences. At this level, the young child may now produce one type of scribble when asked to draw a picture, and a different type when asked to write a letter (Golomb, 1992; Karmiloff-Smith, 1992). Presumably, by beginning to express *Level 1* of graphic production by their first birthday, children begin to take a stance toward pictures that is modeled after the stance taken by other, more advanced individuals in their surroundings. Children begin to act in ways appropriate to pictures: They begin to contemplate them, refer to them, to move a pencil in a relatively controlled fashion around the confines of a page. Yet, at this level, children are still oblivious of the symbolic nature of pictures. Although there is a differentitation made between symbol and referent, this level would correspond to what Nelson and Shaw (2002) described in the realm of language acquisition as the practical use of linguistic symbols without symbolic awareness, or "use without knowledge."

Level 2

Level 2 of pictorial awareness goes beyond basic differentiation between 2D depicting artifacts and the depicted 3D reality. The child is now also capable of appreciating the resemblance as well as the difference between the two. This is the sign of an appreciation of the perceptual similarity between depicting and depicted, without yet any signs of true symbolic awareness. At approximately 3 months, infants habituated to pictures of an object subsequently generalize habituation to the 3D object (Rose, 1977). Infants are also capable of forming so-

phisticated perceptual categories of objects and living creatures that are depicted schematically in pictures (Quinn & Eimas, 1996; Quinn, Slater, Brown, & Hayes, 2001). Thus, at this level infants show an appreciation of the relative similarity between pictures and their referents, as well as the relative similarities across pictures representing the same category of various referents.

In relation to graphic production, at *Level 2* and by approximately their third year, children begin explicitly to label their scribbles, but they do so a posteriori, dressing their scribbles with symbolic meanings. In fact, in this labeling, the young child often points to perceptual similarities between what they discover in their scribbles and objects existing in the environment (Callaghan, 1999; Golomb, 1992; Winner, 1982). It is not unlike the child pointing to a cloud in the sky and labeling it a rabbit. No symbolic intentions are as yet expressed (see Figure 2.2). Children at this level of production awareness do not intend an a priori attempt at making a form to stand for a particular thing in the world. Note however that children at this stage are perfectly adept at producing a rich array of graphic features (lines, circles, dots, etc.) that would be sufficient to produce highly readable symbolic drawings (Callaghan, 1999). At *Level 2*, therefore, the child's awareness of pictorial production and comprehension is essentially perceptual or literal, not yet referential or symbolic.

Level 3

Level 3 of pictorial awareness goes beyond the literal/perceptual to encompass a conceptual understanding of the link between the depicting and the depicted in pictures. It is the level at which pictorial awareness is genuinely referential and becomes symbolic in the following sense. In addition to differentiation and detection of perceptual similarities, toddlers now appreciate the nonidentical equivalence relation between the immediately perceived picture and its referent. For example, when presented with a realistic photo of an apple, the infant realizes that "it is an apple," but *also* that "it is *not* an apple," appreciating the paradox of symbolic identity. The surrealist painter Magritte played on this paradox by naming his realistic painting of a pipe as "this is not a pipe" ("ceci n'est pas une pipe"). The symbol is eventually construed to be at once similar to, but different from its referent. At this level, the child manifests a capacity for "dual representation" or the ability to represent that a graphic representation is both a symbol of something else and a thing in itself (DeLoache, 1987; Olson, 1988; Perner, 1991). As shown in studies by Tara Callaghan in the context of pictures (Callaghan, 1999, 2000a; Callaghan & Rankin, 2002), by Judy DeLoache (1995) in the context of scale model tasks, and by Judy DeLoache and Philippe Rochat for videos (Poss & Rochat, 2003; Troseth & DeLoache, 1998), this ability appears to emerge at around 36 months.

In relation to graphic production, at this level children begin to show a priori planning and intentionality in their drawings. The child begins to produce

graphic forms that bear conceptual equivalence to referents in the world. Now children tend to announce beforehand what they intend to draw. This is the time when infants begin to produce simple forms such as tadpole drawings (a round shape with lines for limbs) to stand for people (Callaghan, 1999; Cox, 1992; Golomb, 1992; Piaget, 1962; Winner, 1982). These are the first genuine symbolic and referential productions by the child, sharing a bare graphic equivalence with referent objects and people.

Level 4

Beyond genuine symbolic awareness, at *Level 4*, the child manifests awareness that referents can be symbolically depicted in multiple ways. They show increased flexibility in their greater appreciation of the abstract and conceptual quality of pictorial representations. Starting at age 3, research shows that children begin to construe drawings as symbols of the same referent independently of the medium and across marked variations in drawing styles, whether color paintings, black and white drawings, or simplified child-like graphic outlines (Callaghan, 1999). The child has essentially achieved symbolic constancy, or the ability to accept a variety of surface forms of a symbol as referring to the same underlying meaning.

In relation to graphic production at *Level 4*, a variety of forms are now used to depict a referent, depending on the purpose of the drawing. For example, a child may use the tadpole schema to depict a person in a drawing of a snake and person, but a more highly differentiated form (e.g., addition of wild hair, big feet) to distinguish themselves from their parent in a drawing of their family. Thus, *Level 4* productions like comprehensions, indicate an appreciation for a wide range of possible, effective, symbols.

At *Level 4*, both in terms of comprehension and production, the child manifests symbolic flexibility and symbolic constancy. Children now explore the variety of ways objects, people and events can be represented via graphic sketches. There is a new appreciation for the wide range of possible, effective symbols.

Level 5

Level 5 corresponds to the final or "Meta" level of symbolic functioning according to the model. At this level, children 5 years and beyond begin, like adults, to construe not only the relative identity of the symbol and its referent, but also the relative identity of the person who produced the symbol, or for whom the symbol is destined. When either comprehending or producing graphic symbols, the child is now keeping either the producer or the reader of the symbol in mind. In other words, graphic representations are now construed in refer-

ence to intentions: the artist's intention in the realm of comprehension, and the intended audience in the realm of production.

In relation to comprehension, the "aboutness" of pictures expands to include the mind of the communicator or artist. The child now appreciates that someone is behind the picture, namely an intentional producer intending to convey a particular message. The child begins to derive meaning by holding in mind the putative intentions of the symbol creator or artist. From 5 years of age, children take into consideration mental attributes of the artist in their interpretation of pictures (Callaghan & Rochat, in press; Callaghan, 1997, 1999, see description below).

In relation to production, it is also by 5 years that children begin to manifest self-consciousness in keeping "others" in mind when drawing. Now children can intentionally tailor a drawing to have a particular impact on the audience, or to convey a particular perspective on the world. In an unpublished study of drawing production, Callaghan asked children between the ages of 3 to 7 years to draw pictures that conveyed the emotions of happy, sad, excited, and calm. These emotion terms are well understood by children of this age. From as early as 6 months of age, if not earlier, infants are able to categorize and appear to be sensitive to these emotions (Field, Woodson, Greenberg, & Cohen, 1982; Nelson, 1987; Rochat, 2001), and from the age of at least 3 years children can match these emotion terms to photographs of facial expressions of the emotions (Callaghan, 1997, 1999, 2000b). The children's drawings were classified by a panel of naïve judges as to which of the four emotions were portrayed. Children were then assigned scores for their drawings according to how effectively they communicated the emotion to the judges. It was found that it was not until the age of 5 years that children successfully produced drawings that captured the emotion they were asked to portray. In a separate study, Callaghan (1997) also found that it was not until age 5 that children were able to judge the emotion portrayed in museum art. Thus, it seems that keeping others in mind when viewing as well as when producing art may be closely linked in development.

Interestingly, highly influential visual artists such as Jean Dubuffet or even Pablo Picasso spent a great deal of their mature lives trying to free themselves from the self-consciousness attached to *Level 5* of graphic symbol awareness. They struggled to be free from dictum and dominant aesthetic movements in order to regain individual spontaneity in their production of images. The current infatuation and collecting frenzy of Folk Art and so-called "Primitive" or "Brut Art" reflects a similar reaction from the viewers' perspective. However, at least in the case of artists, it is hard to conceive of the case of no awareness of or concern for what effects their images will have on future viewers: whether they will be understood, liked, and eventually bought. The artists' struggle with self-consciousness in the creative process is not unlike what Japanese Zen masters try to convey in their drawings: the absence of self-world dichotomy or Buddha State. Although beyond the scope of this chapter and research evidence, it is

TABLE 2.1
Graphic Symbol Development

Level	*Age Onset*	
0	/	No differentiation between pictorial symbol and its referent
1	Birth	Basic differentiation between 2D depicting artifacts and depicted 3D reality
2	6 months	Relating similarities between pictures and their referents
3	3 years	Referential understanding of pictures
4	4 years	Symbolic flexibility and constancy
5	5 years	Meta-awareness of the picture maker

possible that this state could represent yet another (seventh) level of pictorial awareness, like the mythical Seventh Heaven, reached by a few, either through disciplined meditation, drug induced ecstasies, or in the abysmal sufferings of mental illness (see e.g., the famous Peyote series of Henri Michaux drawings or the powerful "Collection de l'Art Brut" in Lausanne, Switzerland). This, hypothetical, level would pertain to the intentional representation of the symbolic process itself, with presumably no objects and no audience in mind.

Next, we present summary Table 2.1 depicting the proposed six levels of pictorial awareness as they unfold in development with approximate age onset in relation to pictorial comprehension which, as in other symbolic domains (i.e., language), typically precedes pictorial production (see earlier description).

WHAT DRIVES THE DEVELOPMENT OF PICTORIAL PRODUCTION AND UNDERSTANDING?

The six levels presented above unfold chronologically from birth to about 5 years of age, and represent the full range of basic pictorial awareness. According to our model, they form the range of pictorial processing levels through which individuals constantly oscillate when encountering graphic symbols. We address now the crucial question of what might drive the predictable development of these levels in the first 5 years of human life.

As proposed in the introduction, symbolic development is inseparable from a fundamental need of the child to communicate, and ultimately to maintain social proximity with others. Symbolic development is a special case of social-cognitive development. It is also inseparable from the drive of symbol minded individuals to communicate and maintain close contact with their infants. From a broad perspective, our idea is that symbolic development, as a subset of social cognitive development, is driven primarily by a basic affiliative need or "BAN" in the child and a need to communicate with the child by symbol minded others. What underlies symbolic development is the need to avoid at all cost being socially isolated or separated from others. Symbols, whether graphic or verbal, serve primarily as communicative means to a social end. This social end is the

probing of others and the control of social exchanges in the context of "BAN." This account provides the basic dynamic and motivational backdrop of symbolic development. It does not, however, provide a precise solution to the question of what might be the actual mechanism(s) driving the chronological emergence of the range of symbolic awareness presented above (i.e., Level 0-5 of pictorial awareness), which is discussed next.

Construing symbolic development in these social/relational terms helps to account for not only what develops when symbolic activities and symbolic skills develop (the process of how symbolic development comes about), but also and probably more importantly, what might be some of the mechanisms driving symbolic development. To a large extent, this latter question remains open, with the majority of research to date limited to the kind of description we provided so far: depicting how symbolic development unfolds, not why.

The infancy literature abounds with evidence of early social awareness, in particular the early propensity of infants to imitate and reproduce actions by others (Meltzoff & Moore, 1994), as well as actions that are produced in the context of self-exploration (Rochat, 1995; Rochat & Morgan, 1995). In the context of "BAN," it is through imitation and face-to-face exchanges, as well as through the contemplation of what consequences self-produced actions have on people and objects that infants gain potential control of their relative degree of social affiliation (Gergely & Watson, 1999; Stern, 1985).

At the core of social-cognitive development in general, and symbolic development in particular, there is the propensity to reproduce actions and their effects, whether by imitation, active exploration (trial and error), or observational learning. Note that this propensity is not exclusive to humans, and has been documented in nonhuman primates (Fragascy & Visalberghi, 1989; Tomasello & Call, 1997; Whiten & Custance, 1996) as well as in some avian species (see the remarkable evidence of observational learning in the New Zealand Kea birds reported by Huber, Rechberger, & Taborsky, 2001). What appears however to be specifically human and might be at the origins of the uniquely human symbol mindedness, is *how the propensity to reproduce action develops in the course of the first 5 years of life.*

We propose that symbolic development, like social and cognitive development in general, is rooted in the propensity of infants from the outset to reproduce actions, whether these actions are performed by others or performed by the self. This is a fundamental principle, what we view as a major driving force behind early social and cognitive development (Rochat, 2001, 2002). This reproductive propensity manifests itself first in what Baldwin and then Piaget have described as "circular reactions" or repetitive patterns of self-produced action expressed by infants in the first year of life. It also manifests itself in the numerous reports of early imitation of facial gestures, vocalization, and facial expressions at birth and beyond (Field et al., 1982; Meltzoff & Moore, 1977; Uzgiris, 1999). Infants from birth relate to others via imitation. Imitation is indeed a pri-

mary mechanism of social affiliation and it is also, we suggest, at the root of symbolic development.

As shown by Baldwin (1925) and Piaget (1954, 1962) in their seminal developmental observations, the propensity to reproduce action changes in marked ways in the course of the first 18 months of life and beyond, when children begin to function symbolically by acquiring language and engaging in pretense and other symbolic actions. Thus, what drives symbolic development might rest on changes in the propensity to reproduce actions. In the next section, we present data suggesting that indeed symbolic development is probably the direct consequence of such changes. But first, we review some of these changes and the chronology of their developmental occurrence.

We propose three main changes in the tendency to reproduce actions over the course of the first 5 years, ranging from reproducing actions on the basis of *emulation* in the course of the first year, to the reproduction of action via *imitation* by the second year, and eventually via the process of *simulation* by 4 to 5 years of age.

Emulation in the First Year

Between birth and 9 months, infants appear to be focusing exclusively on the consequences of actions they reproduce, whether their own or those of others (Piaget, 1954, 1962). At this first stage, the reproductive propensity of the infant corresponds to achieving those consequences by whatever means, a process referred to as *emulation* (Tomasello Kruger, & Ratner, 1993).

Imitation in the Second Year

From approximately 12 months and up to the end of the second year, the reproductive propensity of the child bypasses mere emulation of action to add an element of *identification* with the agent of the action. The child now not only reproduces consequences, but in addition shadows the way the action was produced (Meltzoff, 1995, Tomasello et al., 1993). At this second stage, the reproductive propensity of the young child corresponds to a process of *imitation.*

Simulation From 3 Years of age

By their third birthday, children go beyond shadowing by identification and begin to reproduce actions by re-enacting the motives, plans, and attitudes of the agent that led to a particular effect. The emphasis now is on the *simulation* of the action and its consequences via a psychic projection into the mind of others (see e.g., Harris, 1989 for a discussion of this process in the context of emotional understanding). This final stage opens the door to such generative activities as pretense and feigning acts. At this stage the child becomes genuinely what

Tomasello (1999) terms as *perspectival*, like actors learning their roles in theater. In the context of pictures, the viewer simulates the intentions of the artist while contemplating pictorial symbols, and the producer simulates the mind of the viewer as she creates pictorial symbols intended to sway that same mind.

Next, we present empirical evidence from our work on graphic symbol production and comprehension supporting our views on the social factors driving symbolic development. This evidence pertains to infants' emulation of a contemplative stance toward pictures, the emergence of simulation in the understanding of pictures, and the role of social exposure and scaffolding from adults in the development of graphic symbol production and comprehension.

1. Emulation of a Contemplative Stance Toward Pictures by Young Children. In a recent study (Callaghan et al., 2003) we investigated infants' understanding of pictures by contrasting actions 6- to18-month-old infants take toward pictures of objects, as compared to actions they take toward the objects depicted in those pictures. In a first study, we presented infants with high quality photographs of infant toys, and the toys themselves. We gave either photographs or toys to the infant for unrestricted exploration, or held them down while the infant explored them. Up to 9 months of age, we found that when presented with photographs, infants tended to grasp at the depicted object in apparent confusion of symbol and referent. These findings replicated what was previously reported by DeLoache et al. (1998) and Perner (1991). However, we made these observations only when pictures were held down on the table by the experimenter. When infants could freely explore the picture they showed less confusion between symbol and referent (i.e., made fewer attempts to grasp pictures). However, the nature of pictorial exploration changed over development. Six-month-olds were just as likely to slap, bang, mouth, push, and pull a picture as they were to look at it. In effect they treated pictures the same way they treated the depicted 3D objects when placed directly in front of them for exploration. In contrast, beginning to a small degree at 9 months and increasing in magnitude until 18 months, infants started to look more at pictures than manually explore them. In contrast, they tended to engage more in manual exploration of the 3D objects. We reasoned that beginning around 9 months of age infants might be adopting the stance that others take toward pictures as part of their developing inclination to engage in triadic social exchanges, in particular joint attention and social referencing (Rochat & Striano, 1999; Striano & Rochat, 1999; Tomasello, 1995).

To test this idea, we conducted a second study where an adult experimenter modeled to the infant a particular stance toward pictures and objects. The goal was to assess the extent to which such modeling could influence the infant's behavior toward pictures vs. objects. Two stances were modeled: a picture stance that corresponded to a contemplative attitude of the experimenter toward either the object or the picture, and an object stance that corresponded to a hap-

tic exploration and manipulation of either the object or the picture. Both stances were taken with both types of items (picture of objects or objects) in a between-subjects design.

We found that by 12 months of age infants tend to model the stance previously taken by an experimenter toward a picture, whether it was a contemplative or object stance. They contemplated or manipulated the picture according to what the experimenter did. Interestingly, this modeling did not exist for the 3D objects. Thus, the modeling effect was specific to pictures, and did not occur for the directly perceived objects. The results of this study provide strong evidence that the contemplative and referential stance required by pictures is socially constructed from the first year of life. Since only very few infants imitated the precise actions modeled by the experimenter, the process of reproduction at this stage of development would correspond to a process of emulation rather than the richer and more mentalistic process of imitation or simulation. What is reproduced by the 12 month-old infant is the general attitude and posture of the experimenter toward the picture, not her presumed intended act of deciphering its meaning. In other words, the modeled contemplation of pictures observed in 12 month-old infant is an instance of what Nelson and Shaw (2002) labeled a use without knowledge. Indeed, such emulation does not correspond yet to a genuine understanding of pictures as symbolic representations of their referent. As we will see below, such understanding develops beyond infancy, based on a process that is more than the emulation of others' attitude toward pictures.

2. Developing Simulation of the Image Maker. In a recent study (Callaghan & Rochat, in press) we explored the refinement in older children's understanding of the symbolic function of pictures. We asked the question: When do children begin to understand that in addition to information about the referent, a picture may also contain information about the person who created the picture? In particular, we asked when children (aged 2-7 years) come to consider the attributes of the artist behind any picture. We were also interested in exploring whether children's developing theory of pictures was related to their developing theory of mind.

In a series of three studies we presented children with pictures drawn by different artists, told them about the artists through stories and photographs or short video clips, and then asked them to match drawings to artists. A range of attributes of the artists was explored across the three studies including age (4 yrs, 11 yrs, adult), sentience (machine vs. human drawing), affective style (agitated vs. calm), and emotion (happy vs. sad).

The first two studies confirmed that around the age of 5 years young children begin to consider attributes of the artist when construing and matching pictures to their makers. In the final study of the series we replicated the effect with a new attribute (emotion), and also reported a link between performance on

the picture judgment task and performance on a standard false belief identity task (Perner, Leekham, & Wimmer, 1987).

Although these studies do not directly manipulate simulation by the child, they do suggest that at around the same age that traditional theory of mind tasks indicate that children begin to consider the mental state behind others' behavior, young children also consider the mental state behind others' symbolic productions (i.e., age, sentience, emotion, and affective style). As proposed by Harris (1989) or Tomasello (1999), simulation of others' states of mind and the ability to re-create mentally the perspective of others is the most likely process by which children begin to factor the mental life of the symbol maker behind the symbol. Future research should attempt gaining control over the proposed simulation mechanism in order to determine that it, and not a lower level cognitive process, underlies the sophisticated meta-understanding of pictures.

3. The Role of Social Scaffolding in the Development of Pictures as Symbols. A number of studies confirm that children's symbolic functioning is f a-cilitated and potentially depends on the scaffolding efforts of developmentally more advanced others. In one study, Callaghan (1999) showed that a social communicative game can facilitate the understanding of the symbolic status of pictures. Furthermore, Callaghan showed that intentional production of representational drawings does not appear until symbolic understanding has occurred (at 3 years).

In this study, children aged 2 to 4 years were asked to draw pictures of simple objects and then use those pictures to indicate to the experimenter which of two objects to choose in a social-communicative game. In the next phase, children were shown the experimenter's symbols and had to use them to choose the appropriate object. Following this two-phase game, involving first production then comprehension of symbols, children drew a second set of drawings. The results showed that at 2 years, children were not yet able to use the experimenter's pictures as symbols of a target object and did not produce effective symbols. For example, children may draw a circle to denote both a regular ball and another ball that also had long rubber strings protruding from it. In contrast, 3- and 4-year-olds produced more effective symbols after the game and improved their drawings even more if they were given feedback that their symbol had not been effective. These findings with older children demonstrate the apparent importance of social exposure and training to the communicative use of pictures as symbols.

In a second study pointing to the social determinants of pictorial understanding, a variant of the standard joint attention paradigm (Tomasello & Farrar, 1986) was developed (Callaghan & Pencer, 1999). In this research, novel objects were graphically labeled by an adult experimenter. The aim was to determine whether such labeling of an attended object facilitated comprehension and production of visual symbols in children aged 2 to 3.5 years. In the graphic labeling

task the experimenter made a quick graphic sketch of either the child's (attended) or the experimenter's (nonattended) object. The experimenter ensured that the child watched as the drawing was made. Children were then given comprehension and production tasks that included the objects they had seen drawn, as well as those that were not drawn. Two-year-olds showed better comprehension but not production for pictures they saw the experimenter draw and 3.5-year-olds, who were at ceiling for comprehension, showed better production for objects they saw the experimenter draw. Unlike the case of language (Tomasello & Farrar, 1986), performance was not influenced by whether the experimenter followed in or directed children's attention.

A variant of this graphic labeling procedure was used as training in a third longitudinal training study (Callaghan & Rankin, 2002). At the outset of the study, children aged 2 years 4 months showed no signs of symbolic understanding of pictures when asked to find objects depicted in realistic drawings. They were effectively at chance in the comprehension task and no child had yet produced a representational drawing. The main aim was to determine whether training would facilitate pictorial comprehension and production. A second aim was to determine whether graphic symbol development was related to symbolic development in other domains. Comprehension and production with language, visual, and play symbols were measured at monthly intervals for all children from the onset of the study until their third birthday. In the experimental group, eight children were given training at weekly intervals for a 4-month period, beginning at 28 months. This training consisted of asking the child to pull one object out of a cloth bag containing a dozen objects. Then, the child held the object while the experimenter made a quick graphic sketch of it. While drawing, the experimenter ensured that the child was always focused on the drawing, pausing whenever the child looked away. Following each drawing, the drawings and objects were placed together in a line on the table. At the end of 12 drawings, the experimenter replaced the toys in the bag and the game was repeated so that in total the child watched 24 drawings of particular objects being produced. A control group of eight children received placebo training (no drawings were produced, but objects were taken from the bag, held by the child and lined up on the table) for the same period. These children were then given 4 weeks of training in the fifth month of the study. The results of the study indicated that after 2 months of training, the experimental group began to show marked increase in symbolic comprehension of pictures compared to control children, who showed no progress. Production was positively influenced by training after 3 months for the experimental group, and in sharp contrast, no children in the control group produced any representational drawings during the first 3 months. Once the control group received their late training in the fifth month, they did show sudden marked progress of symbolic functioning on both comprehension and production tasks. Parallel testing in other symbolic domains indicated that produc-

tion and comprehension in the pictorial domain correlated with production and comprehension in language and play domains.

In all, the results of these three studies clearly demonstrate that social scaffolding plays a role in facilitating the development of symbolic functioning, at least in the pictorial domain and with probable generalization to other symbolic domains.

CONCLUSIONS

In this chapter, we presented six levels of pictorial awareness as they appear to unfold between birth and 5 years of age. We construed that these levels constitute the range of general symbolic awareness within which individuals 5 years and older tend to oscillate depending on their behavioral state and the circumstances of their encounters with symbols. Based on three bodies of empirical evidence pertaining to changes between 6 and 60 months in the understanding and production of pictures as symbols, we also proposed that the force behind development of symbolic awareness is social. Overall, our research demonstrates the putative importance of social factors in symbolic development. In the first year of life, we found that infants tend to emulate the particular (contemplative) stance taken by adults toward pictorial artifacts as opposed to 3D objects. We also observed that young children are sensitive to and depend on the symbolic scaffolding from other, more mature symbol minded individuals. Finally, we found that children develop beyond mere emulation and imitation, such that in their fourth and fifth year they become explicitly aware of the intentional nature of symbols. By this age, children begin not only to consider the relation between symbols and their referents, but also begin to consider the mind behind the symbol. Children now factor in the person who produced the symbol via, we presume, a process of simulation. The use of simulation may possibly be the hallmark of what it is to be a member of the "human," as opposed to other animal, species. At this ultimate level of symbolic awareness, graphic symbols not only stand for things or events, they also stand for the psyche of the person who made them.

This final "meta" level of symbolic awareness (fifth according to our model) is inseparable from the basic force driving symbolic development. We gave this force the acronym of BAN which stands for Basic Affiliative Needs. To understand the mechanisms that drive the child toward symbol mindedness, it is necessary to refer first and foremost to BAN. Symbolic development is indeed inseparable from the basic need to maintain social proximity, create contacts with others to foster intimacy and to promote the sharing of experience. This process, we believe, manifests primarily via the reproduction of actions that are either self-produced or produced by others.

The name of the game is to maintain social affiliation and proximity. To play this basic game, children from the earliest age tend to behave in ways that resemble the behavior they see in others, and to produce actions that correspond to the actions of others. This is the process that underlies the social "ganging" that is particularly pronounced in teenagers who dress, talk, and behave in analogous ways, ostentatiously sharing likes and dislikes. It is also via such a process that infants from a very early age establish their links with others. In this process, other symbol minded individuals recognize themselves in the reproductive actions of the child. We view this active reproductive process as the core mechanism that feeds BAN and ultimately also feeds symbolic development. Not unlike the social ganging of teenagers, young children are bound with symbol minded peers (and caretakers) and eventually become symbol minded themselves, first via emulation, then via imitation, and finally via simulation.

In conclusion, we tried to make the case that symbolic development needs to be construed in the context of BAN, particularly if we try to go beyond the mere description of how symbolic development comes about to identify the mechanisms and motivational systems that drive this development. In the search for these mechanisms, we cannot overlook that at the root of this development there is the fact that infants become symbol minded primarily to find intimacy, make meaning, and create values that can be shared with other, more advanced symbol minded individuals.

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