Abstract

In two studies, we examined whether and how 3- and 3½-year-old children were able to use object information from their own drawings to solve a task. The children had to produce drawings of simple objects and then use the shape and/or colour of their pictures to identify replicas of the referents depicted. The results showed a relationship between graphic production and use. In Study 1, when shape was the single distinctive cue across objects, only the older group was able to produce and use drawings effectively. In Study 2, 3-year-olds used their drawings effectively when not only shape, but also colour, were available as cues to identify the objects portrayed. Although most 3-year-olds' drawings did not reflect the shape of the referents, by incorporating colour young children demonstrated to recognize the intention behind their own representations and used them to solve the task. Our findings are discussed in line with intentionality and Theory of Mind.

Keywords: preschool children, drawing, production, use

When Colour Takes Shape: Young Children Use Object Information from Their Own Drawings to Solve a Task

A hallmark of children's symbolic development is the ability to understand, produce and use drawings. Drawings, as external representations, have a physical permanence that allows them to be stored, retrieved and shared (Donald, 1991; Tolchinsky, 2003). This feature is critical because it enables pictures to serve a variety of purposes, such as to communicate information to other people, to express ideas or feelings and to recall information and experiences. Although pictorial comprehension and production have been widely studied (for a review, see Jolley, 2010), little research has been conducted that focuses on young children's use of their own drawings.

To be successful at using their drawings with a specific purpose, it has been argued that children would need to produce straightforward pictures with regards to what they are meant to represent (Triona & Khlar, 2007). A large number of studies reported that school-age children are successful at creating and using their drawings for puzzles and problems (Eskritt & Lee, 2002; Eskritt & McLeod, 2008; Garcia-Mila, Teberosky, & Martí, 2000; Hughes, 1986; Martí, Garcia-Mila, & Teberosky, 2005); preschool children were only included in a minor number of studies (Garcia-Mila et al., 2000; Martí et al., 2005) and struggled to successfully complete these tasks.

Triona and Klahr (2007) addressed that one possible explanation for why preschool children find challenging to use their drawings are due to age-related changes: with age, children tend to become skilful at producing representations and they are therefore more likely to decode and employ them successfully. However, these authors also pointed out that there is considerable discrepancy between developmental patterns reported in the literature due to variations in the type and amount of information children had to represent across tasks. For instance, 5-year-olds were successful at

producing and using representations of objects to retrieve the content of cards or boxes (Eskritt & Olson, 2012; Garcia-Mila et al., 2000), but older children (ages 6 to 10 years old) found creating representations difficult when they had to depict two types of information, object and location, in order to solve a memory card game (Eskritt & Lee, 2002). These mixed results challenge the assumption that age could explain these findings and suggest that task constraints (i.e., the amount and type of information required for the representation to be adequate for later use) may have a crucial effect on children's ability to use their own external representations.

Children's first attempts to produce graphic representations develop within the first two years of life, initially in the form of scribbles (Golomb, 1992; Kellogg, 1969). Luquet (1927) argued that between a period of scribbling - producing non-representational shapes - and the emergence of conventional depiction, children start to include a selection of the referent's features into their drawings. Nevertheless, at this stage in their development, children's traces tend to be displayed in an uncoordinated manner; a phase named by the author as 'failed realism'. In line with the coding scheme used by Jolley et al. (2000) and for the purpose of this research, we will refer to these representations as 'pre-conventional drawings'.

From their third year of life, children's traces become much more controlled and real or imaginative objects begin to be recognised from their pictures (Cox, 2005; Golomb, 1992; Winner, 1982). Golomb (1992) claimed that the emergence of representational depiction relies on children's ability to produce enclosed forms (e.g., the circles and lines). One of the first conventional representations children attempt are human figures. These tend to appear in the form of 'tadpoles' (i.e., a circle with arms and legs, or just legs, emanating from it). Children's drawings become progressively

more realistic and detail-oriented. In addition, children also start to consider the receiver of their pictures whilst deciding what to portray (Winner, 2006).

The current research will focus on the relationship between graphic production and children's use of their own drawings. Young children showed the earliest success in pictorial production and use when they were only asked to portray the shape of an object (Callaghan, 1999). This author asked 2- to 4-year-old children to draw the distinctive shapes of an array of same-colour objects; these objects were specially chosen because they required the use of very simple shapes (circles and lines) to be depicted. Children were explicitly told that the purpose of the representations was to direct a second researcher to choose the right object to drop down a tunnel. On the children's first attempt to represent the objects, 42% of the 3-year-olds and 70% of the 4-year-olds drew the objects using their distinguishing shapes. At the end of the session, children were asked to draw the objects again, to examine whether this experience had an impact on their graphic production. Fifty-five per cent of the 3-year-olds and 85% of the 4-year-olds had produced effective representations, whereas none of the 2-year-olds were successful in both attempts. These results indicate that children begin to produce effective drawings of simple objects to communicate information to other people between 3 and 4 years of age.

An important limitation in the majority of the studies reviewed here is that children were asked to produce representations for another person, who was required to solve a given problem; however, once they had finished, their productions were hardly ever interpreted or used and their effectiveness has never really been tested. The one exception to this is Callaghan's research (1999), in which the second researcher actually used children's drawings. Nevertheless, whether young children are capable of using their own drawings remains an open question. The present research was designed to

study this issue further. Our aim was to examine whether or not 3 and 3½-year-old children were able to use object information from their own drawings to solve a task, and how they did so.

We carried out two studies. In both studies, children had to depict five objects, each one stored in a different box, and they had to use their drawings later in order to fill the boxes with a replica of each object. The objects differed in shape (balls and sticks) or both in shape and colour. As a result, children had to portray the distinguishing features of the objects in order to be able to use their drawings as a tool to match each object with its replica. In this way, this task allowed us to assess the relationship between pictorial production and the use of such production; whether or not young children were able to adjust the content of their drawings to their needs and how they might do so.

The specific aim of Study 1 was to determine whether 3- and 3½-year-old children could use their drawings when shape was the single object information available. We expected a positive relationship between children's graphic production capacity and the functional use of their own pictures. Based on studies reporting that between 3½ and 4 years of age children begin to produce conventional drawings (Callaghan, 1999; Jolley, 2010; Authors, 2017), we predicted that only the older age group would be able to produce effective representations of the objects' distinctiveness and, therefore, successfully use them to solve the task.

Study 2 was designed to assess whether 3-year-olds would successfully use their drawings when not only shape, but also colours were available as cues to identify the objects portrayed. Under this condition, each object differed from the rest of the set in shape and colour (for example, object 1 was a big green ball and object 5 was a yellow stick). We expected that colour would be an effective cue for children to create graphic

representations, particularly for the children who struggled to include shape information in Study 1. If this is the case, we would be able to provide evidence that children who are not yet making conventional drawings are nonetheless capable of grasping and using the referential intentions behind their depictions (Freeman, 1995, 2008). Research shows that children are capable of naming their own pictures even when shape cannot cue intention from 3 to 4 years of age (Allen, 2009; Bloom & Markson, 1998; Gross & Hayne, 1999). From this perspective, drawings are conceived as manifestations of the artist's mind (Wollheim, 1993) and understanding of intentions has been identified as a precursor of a theory of mind (ToM, Colonnesi et al., 2010), a process that involves attributing and reasoning about their own and others' mental states (Perner, Leekham, & Wimmer, 1987; Wimmer & Perner, 1983). ToM skills have been demonstrated to predict children's ability to communicate (Myers & Liben, 2012) and interpret meaning (Callaghan & Rochat, 2003) from pictorial symbols. Although this developmental milestone has the potential to drive symbolic development and it is therefore relevant to our research, other studies have shown that children rely on the mental state of the artist as long as it is not pitted against resemblance (Browne & Wooley, 2001; Hartley & Allen, 2015). With this in mind, we will examine children's success using their own drawings based on the features from their referents included in their graphic representations.

To the best of our knowledge, there is limited literature on children's graphic production and use of different types of object information. Eskritt and McLeod (2008) employed a 'store task' in which 5- to 7-year-old children had to depict the shapes (circles, rectangles or squares) and the colours (red, green or blue) of an array of cards in order to place a 'customer' (a puppet) orders. To be successful, children had to incorporate both features of the objects into their depictions. Less than half of the

children performed at the highest rate, producing both effective representations and completing the store task. Unlike this study, our procedure was specially designed to simplify the amount of information required for children to solve the task; children in Study 2 did not have to portray both shape and colour distinctions to be successful. Our hypothesis was that by only depicting colour information, even children whose drawings fall into the pre-conventional category could use their drawings effectively. Hence, this research allowed us to explore the functional use of drawings both in conventional and in non-conventional young drawers.

Study 1

Method

Participants. Fifteen 3-year-old children (seven girls and eight boys, M_{age} = 36.4 months, age range: 35-37 months) and 15 3½-year-old children (six girls and nine boys, M_{age} = 42.4 months, age range: 41-43 months) were recruited from day-care centres in a large city (to be completed after review process). The socioeconomic status of their families was middle-class, based on the level of education (college and university) and occupation (professionals and entrepreneurs) of their parents. Teachers confirmed all students had previous experience producing drawings of different shapes and colours with both crayons and pencils such as the ones used in these studies, in line with preschool educational programs of (to be completed after review process). An additional child was excluded because he did not engage in the task and thus provided no usable data. Informed written consent was obtained from all parents or caretakers.

Materials. The materials were two stimuli sets consisting of five objects identical in colour (blue): (1) a ball; (2) a ball with small wooden sticks attached; (3) a ball smaller than 1 and 2; (2) two balls joined together; and (5) a wooden stick. Two additional objects were used as distractors. These objects were specially chosen because

they could all be portrayed using either a circle or a line or a combination of them (Figure 1). In addition, we controlled the effects of verbal labels on the pictorial task (see Hartley & Allen, 2014; Long et al, 2012): all referents were presented to the child as 'toys made out of either balls and/or sticks' and then, subsequently referred to as 'toys'.

A graphite black pencil and plain sheets of A4 paper were used by all children to produce the drawings. Five green boxes (20 cm x 32 cm x 11.5 cm), a cardboard paper bag and adhesive tape to glue the children's drawings on the covers of the boxes were also used.

Insert Figure 1 about here

Procedure. The procedure was specially designed for this research. A complete session lasted around 15/20 minutes and was videotaped. Children were tested individually in a quiet room of the day-care centre they attended by a trained researcher. Each child sat at a small table next to her. To establish rapport, the session began with a brief warm-up period in which the researchers talked to the children about what they have been doing that day. When the children appeared to be comfortable, the task began. The task consisted of two phases: production and use.

Production phase. The researcher told children that they were "...going to play a game with these boxes and these toys (she showed the objects one by one, allowing children to explore them for a few seconds). Could you help me to place each toy into one different box?" The researcher gave the toys one at the time and encouraged children to put them into the boxes. Once the objects were stored inside the boxes, they were closed and aligned in front of children at one side of the table. Then, the

researchers said: “Oh! Now, how are we going to remember where each toy is? I have an idea! How about if you make a drawing of each object and we glue them on the boxes’ lids? That way we'll know where each toy is. Then you will use your drawings to play a game”. The researcher opened one box at a time, picked up the toy contained inside, in a predetermined random order, and held it in front of the children for them to draw it. Before the children started to draw, the researcher reminded them that their drawings should help them know which toy was stored inside every box. Each drawing was made on a separate paper sheet. Once a drawing was completed, the researcher labelled the object depicted on the other side of the sheet, placed the toy back in the box, closed it and glued the drawing to the box’s lid. Half of the children drew Object 1 first and the other half started the task by depicting Object 5 (see Materials). These drawings were required first because they involved the production of the simplest shapes of the set, a circle and a line.

Use phase. Once all drawings were completed, the researcher showed children a bag containing the replicas of the hidden objects plus the two distractors. Children were told: “Look, here I have other toys. Some of these toys are identical to the ones you have just drawn and hidden inside the boxes. What you have to do now is to choose an identical object to the one hidden in each box. Your drawings will help you know which toy to choose”. The researcher picked up the objects from the bag and aligned them within children’s reach. Without pausing, the researcher presented five trials. On each trial she picked up a closed box, held it in front of children for them to see the drawing glued to the lid and said: “Which toy can we put inside this box? Remember that your drawing (researcher is pointing to it) shows you which toy is hidden inside”. If necessary, children were given prompts such as “Show me another toy like this one”. Children were also instructed not to open the boxes before selecting an object.

After the children made a choice, the researcher opened the box and compared the target object with the object chosen by the children. If the children made a correct choice, they were told: “Very good, the toys match!” If the toys did not match, the researcher said: “Oh, that was not the one!” and asked children what might have happened. Responses to the researcher’s questioning were uninformative (e.g., ‘I don’t know’ and ‘Just because’), therefore, they will not be discussed here. In order to control that children would base their choices on the content of the drawings rather than on the memory of the object’s location, the order in which the boxes were presented was different from the order in which the objects were drawn and hidden inside the boxes.

Coding and analysis. The dependent variables were the number of *shape drawings* created by children in the production phase of the task and the number of *effective drawings* in the use phase (maximum of 5 in both cases).Shape drawings had to portray the following distinctive features of the objects:

- Circle. Object 1 should be depicted with a bigger circle than Object 3;
- Circle + lines. Object 2 should be depicted with lines emanating from a circle;
- Size. Object 3 should be depicted with a smaller circle than Object 1;
- Number. Object 4 should be depicted with two circles;
- Line. Object 5 should be depicted as a line.

Children’s drawings were classified by two independent judges who compared pairs of drawings relevant to each distinction (for example, size) from 25% of the sample (agreement = 96%; k = .089). Cases of disagreement were resolved through discussion.

Regarding the use phase, ‘effective representations’ was equal to the number of times the children successfully matched a drawing with a replica of the object stored in

the box. Children were scored "1" when they chose an object identical to the target and "0" when children chose a different object. Effective drawings were expected to be graphic representations that contain the information needed in order to solve a particular task (Williats, 2005). In the content of this research, this means a picture which contains the object's distinguishing shape. All statistical analyses were performed using SPSS, version 23.0, with a 5% level of significance. Kolmogorov-Smirnov test showed the data obtained both from the production phase and the use phase were not normally distributed ($z = .175$, $p = .001$ and $z = .256$, $p < .001$, respectively), thus nonparametric analyses were applied.

Results

First, we tested the effects of age in children's performance in production and use phases. Second, correlations between children's performance in both phases within each age group were conducted, along with an analysis of individual performance. Preliminary Mann-Whitney *U* tests revealed no effects of gender ($U = 427.5$, $p = .95$) or trial order ($U = 427.5$, $p = .44$) in this study, so these variables will not be discussed further. To provide an initial view of any patterns in the data, the percentage of children's performance in both phases were calculated.

Three-and-a-half-year-old children produced 72% of shape drawings (54 out of 75) while 3-year-olds created only 33% (24 out of 75). Table 1 shows individual performance per group and phase. A statistically significant effect of age has been found in children's performance on the production phase of the task, $U = 51.5$, $MSE = 23.668$ $p = .01$, $d = .54$. Performance also varied as a function of age in the use phase: 3½-year-old children effectively used their drawings 73% of the time (55 out of 75) to find a replica of the object stored in the box, whilst 3-year-olds only did it a 33% of the time (24 out of 75), $U = 42$, $MSE = 23.643$ $p = .003$, $d = .63$.

Insert Table 1 about here

In order to examine the link between drawing production and use within each age group, Spearman's rho correlations were performed. A strong positive relationship between children's drawing production and use has been found both for 3½-year-olds [$r_s(15) = .854$, $p < .001$] and for 3-year-olds [$r_s(15) = .593$; $p = .02$].

An analysis of individual performance allowed us to take a closer look at these relationships. For this purpose, we examined the number of children who were either successful in both phases of the task, in only one phase and in none. The scoring criterion for successful performance was strict. To be considered successful in the production phase, children had to create at least 4 out of 5 shape drawings (80%); to be successful in the use phase, they had to use correctly at least the same proportion of their drawings, whether they were classified as shape drawings or not. All of the children who produced shape drawings could use them effectively in the use phase of the task (60% of 3½-year-olds and 20% of 3-year-olds). None of the children who were successful at the production phase had difficulties using their own depictions effectively. On the contrary, when their drawings did not include shape information, mainly because they were non-conventional pictures, children had difficulties to decode the items depicted to find a replica of the object stored in the box (33% of 3½-year-olds and 73% of the 3-year-olds). Finally, only a small number of children solved only the use phase of the task (7% of each age group).

Even though there was a mismatch between production and use of drawings in just a few cases (7% of each group), it is worth noting that those children were still using shape information as a cue to what they thought the referent was. For instance,

some children could successfully identify Object 2 (see Figure 1) even though they only depicted its lines, omitting the circle (for samples, see Figure 2). Object 2 was the only referent that could be portrayed with more than one line, and this shape cue was enough for children to solve the task although the object in the drawing bore little resemblance to its real-world counterpart.

Insert Figure 2 about here

To sum up, the findings of the present study indicate that even young children can accurately use their own drawings to solve a task. Children at 3½ years of age were the most successful on the task because, unlike the younger ones, they demonstrated to have a representational repertoire and the motor skills necessary to create drawings that reflect the distinctiveness of simple referents. Now, would the younger age group improve their performance if the objects had perceptual features whose graphic representations required less representational and motor capabilities? In Study 2 we investigated whether 3-year-olds who draw pre-conventional pictures would be able to use their own graphic production when not only shape but also colours were available as cues to the object's identity. The underlying assumption of this second study was that, under certain conditions, children who struggle to convey the objects conventionally could recognise their referential intention beyond the shapes traced on the paper.

Study 2

Method

Participants. Fifteen 3-year-old children (eight girls and seven boys, M_{age} = 36.72 months, age range: 35-37 months) participated in this study.

Materials and procedure. The materials were the same as those used in Study 1 (Figure 1) with the exception that the objects were also distinctive in colour: Object 1 was green, Object 2 was blue, Object 3 was brown, Object 4 was red, and Object 5 was yellow. Distractors 1 and 2 were pink and purple, respectively. Hence, in addition to the black pencil, children were given seven colour pencils, with matching colours to the target objects and distractors used, to choose from before they started to draw each object. The experimental session was conducted in exactly the same manner as in Study 1.

Coding. An initial survey of the data revealed that children produced different types of drawings under this condition. As a consequence, the dependent variable in the production phase was the type of cues children included in their pictures. In addition to the *shape drawings* category (1), drawings were classified as: (2) *colour drawings*, when only information about the colour of the objects was included in the pictures; (3) *shape and colour drawings*, when the pictures had both matching shapes and colours to their referents; and (4) *no cues drawings*, when they appeared not to contain any useful information to aid children recognition of the object portrayed. Children's drawings were classified by two independent judges who compared pairs of drawings relevant to the type of cues contained in a quarter of the sample (agreement = 95%; k = .091). Cases of disagreement were resolved through discussion. Preliminary Chi square analysis showed no statistical differences in children´s performance across sex ($\chi 2$ (3, N = 75) = .672, p =.88) and order of presentation of the objects ($\chi 2$ (3, N = 75) = .784, p = .853). Therefore, these variables will not be discussed further.

The frequency of *effective drawings* was the dependent variable in the use phase, in the same manner as in Study 1.

Results

Figure 3 shows 3-year-olds' performance in both phases of the task. In the production phase, 75% of children's drawings (56 out of 75) contained at least one cue to their referents; the remaining 25% (19) were no cues drawings. Concerning the drawings that contained distinguishing features of the objects, 61% (34 out of 56) were classified as colour drawings, 27% (15 out of 56) as shape and colour, and only 12% (7 out of 56) as shape drawings. Chi square analysis indicated that children were significantly more likely to produce colour drawings out of all the categories, $\chi 2$ (3, N = 75) = 20.52, $p < .001$. The frequency of this type of drawings was statistically different from shape drawings ($\chi 2$ (1, N = 41) = 17.78, $p < .001$), shape and colour drawings ($\chi 2$ (1, N = 49) = 7.367, p = .007) and no cues drawings ($\chi 2$ (1, N = 53) = 4.245, p = .039). Shape and colour drawings were not significantly different from neither no cues drawings ($\chi 2$ (1, N = 49) = .471, p = .493) nor shape drawings ($\chi 2$ (1, N = 49) = 2.909, p = .088). Shape drawings only differed from no cues drawings, $\chi 2$ (1, N = 26) = 5.538, p = .019).

Insert Figure 4 about here

Concerning the use phase of the task, 80% of the colour and shape drawings and 71% of the colour drawings were effective for children to find a replica of the object stored in the box. Meanwhile, 43% of the shape drawings and only 11% of the no cues drawings were classified as effective drawings. Table 2 shows individual performance in the use phase and across drawing type. In order to assess the link between graphic production and use, firstly we analysed the frequency of effective drawings across categories. Fisher exact tests showed that only the amount of effective colour and shape and colour drawings were significantly different to no cues drawings successfully used

($p < .001$ in both cases). No differences have been found between effective colour drawings and colour and shapes drawings ($p = .205$) or between the aforementioned drawings and effective shape drawings ($p =. 205$ and $p =.145$, respectively).

Insert Table 2 about here

Secondly, we conducted separate $\chi 2$ goodness of fit tests analyses within each drawing category. This analysis showed a decline of success in using the drawings when children did not include colour cues in their pictures. Significant statistical differences have been found between the frequency of effective and ineffective drawings in both colour ($\chi 2$ (1, $N = 34$) = 5.765, $p = .016$, $r = .412$) and shape and colour ($\chi 2$ (1, $N = 15$) = 5.4, $p =.02$, $r = .600$) categories. Children effective shape drawings did not differ from the ineffective ones, $\chi 2$ (1, $N = 7$) = .143, $p =.705$, $r = .145$. Finally, the frequency of ineffective no cues drawings were significantly different from the effective ones, $\chi 2$ (1, $N = 19$) = 11,842, $p= .001$, $r = .760$.

In sum, these results are in line with our hypothesis: 3-year-old children improved their performance creating and using their own drawings when colour was an available cue to the object's identity. Although most of their drawings did not reflect the shape of the referents, by incorporating colour these children were able to successfully use them to solve the task. Thus, early in symbolic development, children seem to be showing evidence of developing an implicit knowledge about the intended purpose of their own drawings as communicative tools.

Discussion

These studies have proposed to investigate whether young children produce and use the content of their drawings to solve a simple task and how they do so. To the best

of our knowledge, this is the first research where children's success using their own pictures depended on them depicting a single object information about the referents. Unlike pictorial understanding and production, the use of pictures has received considerably less attention, particularly the ones produced by children themselves.

In Study 1, we addressed children's performance when shape was the only object information available. Our results show that 3½-year-olds, and not children just 6 months younger, produced conventional drawings and effectively used shape as a cue to interpret their depictions. Children's performance on the production phase of the task is in line with previous findings in drawing development research regarding the onset of conventional production of pictures of simple referents between the ages of 3 and 4 (Callaghan 1999; Jolley, 2010; Authors 2017). The current study provides additional evidence of consistency between children's ability to produce conventional drawings, as functional representations of the objects' distinctiveness, and the successful use of these representations. In good agreement with previous studies about children's use of their own external representations (Eskritt & Lee, 2002; Eskritt & McLeod, 2008; Eskritt & Olson, 2012; García-Mila et al., 2000; Hughes, 1986; Lee & Karmiloff-Smith, 1996; Martí et al., 2005; Tolchinsky-Landsmann & Karmiloff-Smith, 1993), we have found an age effect in both abilities, the production of unambiguous and informative drawings and the effective use of these symbols. However, unlike previous studies, our findings revealed a relationship between pictorial production and use from the third year of life.

Previous research indicated that preschool children were unable to employ their depictions successfully. However, upon closer examination, the external representations they had created to communicate information to themselves required not only to represent object information, but also location (Eskritt & Lee, 2002) or numerical representations (Bialystok, 1992; Bialystok & Codd, 1996, 2000; García-Mila et al.,

2000; Martí et al., 2005). Furthermore, other studies (Eskritt & McLeod, 2008; Eskritt & Olson, 2012) employed tasks which demanded the depiction of more than one type of information, for example shape and colour. Consequently, it may be possible that the success rate of 3½-year-olds when were asked to depict a single object information could be explained by not only age-related changes but also by task constraints.

A large number of studies (Beal, 1985, 1989; Martí, 2003; Myers & Liben, 2008) argued that the coordination between the states of mind of the producer and the viewer of a representation, even if they converge in the same person, is one of the main challenges when using external symbols in solving different kinds of tasks, and this capacity must rely on at least a rudimentary theory of mind (Wellman, Cross, & Watson, 2001). While drawing, artists are generally aware of what they mean to represent. Nevertheless, this knowledge is a double-edged sword. If the artists overestimate the content of their drawing, that is, if it does not have enough distinguishing features to trigger in a viewer the recognition of his or her intention, the picture will most likely be misinterpreted (Beal, 1985; Freeman, 2008). To communicate information to themselves through drawings, children need to learn to take their own perspective in the future, and to evaluate what information they will need to know once they will have to use their pictures, rather than in terms of the information they have at the moment the drawings are produced. As a consequence, another possible explanation of 3-year-olds' low performance in our task could be that they had difficulties in making a distinction between these two different states of knowledge. More importantly, children seem to be unaware of the content of their drawings which can reduce this difference. This is also in line with previous research by Callaghan and Rochat (2003) showing that only when children demonstrate a solid understanding of their own and other mental states (e.g., when they understand that a puppet will look for

an item where they falsely believe it will be, see Perner, Leekham, & Wimmer, 1987; Wimmer & Perner, 1983), they will also understand how the artist's mind affects their work. Nevertheless, future research should further address the links between children's use of their own drawings and ToM understanding.

Keeping in mind that 3-year-old children are still in a transitional phase between the production of scribbles and the emergence of conventional drawing, Study 2 was designed to test whether children at this age could improve their performance when an additional cue was available, the object's colour. We found that children have a tendency to use colour over shape as a cue to the referent's identity at this point of development: unlike portraying the shape of a referent, choosing a matching colour to represent a given object does not require children to develop a wide variety of cognitive challenges, such as the deciding which aspects of the referent's shape should be portrayed and the motor skill to translate those aspects into marks on paper (Cohen & Bennet, 1997). Hence, colour becomes a more accessible cue to communicate information regarding the object's distinctiveness. This means that even scribbles can become effective drawings for children, as long as their colour matches the referent they intend to portray. Altogether, our findings show that in spite of young children's developing graphic-production skills, they seem to have an implicit knowledge of drawings as communicative tools in order to functionally use them with a specific purpose. Our study moves from providing evidence of children's understanding of the intention behind their own drawings (Bloom & Markson, 1998) to demonstrate how they can use this awareness to solve a specific task.

Young children appear to be especially likely to take for granted a direct colour match between external representations and referents (Armitage & Allen, 2015; Liben & Downs, 1989; Myers & Liben, 2008). Myers and Liben (2008) showed that when 5-

and 6-year-old children were asked to choose the most suitable map to locate an object, they selected the representation that shared the colour of the referent. Armitage and Allen (2015) found a similar pattern of results when they asked 3- to 6-year-olds and adults to find the referent of a picture created by an artist who stated she intended to represent one object (e.g. a blue duck) while the picture resembled a different colour object (e.g. a pink duck). Children and adults matched the picture more often to the identical-colour item than the intended referent. Indeed, a deeper analysis of Study 2 showed children who failed to utilize their own non-conventional drawings in our use task tended to choose objects with matching colours as their visual depictions instead (e.g., if they depicted a green ball with a blue scribble, they chose the blue object).

Clearly, despite their non-conventional appearance, 3-year-olds assigned symbolic content to their drawings: in this way, they could use their own pictures as means of communication. However, an associative strategy (Ganea, Allen, Butler, Carey, & DeLoache, 2009; Hartley & Allen, 2014; Preissler, 2008) using colour cues is also a likely explanation. A replication of a breakthrough study on children's understanding of the intentions behind their own drawings favours this hypothesis (Callaghan & Rochat, 2008). Bloom and Markson (1998), 3- and 4-year olds were asked to depict pairs of pictures whose referents could not be distinguished by shape (e.g., a lollipop and a balloon). After a short break, children were still able to identify each item of the pair successfully. Nevertheless, the researcher provided children with different coloured pencils for each drawing, making them distinguishable by colour. When Callaghan and Rochat (2008) replicated this study, it was found that children were only able to label their own drawings when these varied in colour, and not when this cue was held constant. This finding suggests that children's success in the original study might have been due to relying on colour cues rather than on the artist's

intentions. Although an associative strategy could have guided the selection of the replica object, the results showed that children recognized that their drawings were representations of real objects: they chose which cues capture on paper (production phase of the task) to be able to recover them later in order to solve the task (use phase).

Nonetheless, previous research shows that when the demands of the production task are reduced even further, and children are asked to match already-made pictures of similar objects to their referents, even 2.5 to 3 year-olds are able to do use pictures intentionally without prompts (Callaghan, 1999; Authors, 2016, 2017). More importantly, even at an age at which children struggle to use their own pictures as symbols, previous research showed they can tune into intentional cues from age 2 when completing matching tasks (Egyed & Szalai, 2016; Preissler & Bloom, 2008; Authors, 2016). Therefore, these findings demonstrate that from very early in their lives, children go beyond merely focusing on the perceptual aspects of pictures and reflect a consideration of the role of the artist in pictorial use.

We now turn our attention to the implication of our work. It is particularly worth-noting that the pervasiveness of pictorial symbols production and use in cultural practices: an educational task, an errand to run or an informal social game may require children and adults to produce graphic representations to convey information for record keeping and communication purposes. The omnipresence of pictures challenges both researchers and educators to dig deeper into the understanding of the pictorial domain within a theoretical framework that considers the intentional network between artist, the picture and the audience (Freeman, 2008) and that is sensitive to the communicative contexts in which these interactions occur.

All in all, this research has provided additional evidence that when young children communicate information to themselves through pictures, they are aided by

object information. Nevertheless, pictures can serve not only to communicate information regarding referents but also narrative, expressive or aesthetic purposes. Future studies should address children's early conceptions of the multiple uses pictures have. Finally, our findings have potential implications for the use of pictorial symbols to retrieve information, experiences, and ideas in real-world settings. There is a consensus in literature that drawings increase children's accurate recall of information and events (for a review, see Jolley, 2010) not only in educational contexts, but also in forensic and clinical settings. Young children's use of their own pictures for multiple purposes and in different contexts is still an unresolved matter in developmental research.

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Table 1.

Individual performance across age group and phase.

Number of drawings	Production Phase		Use Phase	
	3 years	3.5 years	3 years	3.5 years
0	4	2	5	1
1	5	0	4	1
2	2	0	1	2
3	0	4	1	1
4	1	3	4	3
5	2	6	0	7

Table 2.

Individual performance in the use phase across drawing type.

Number of drawings	Shape		Colour		Shape/Colour		No Cues	
	E	NE	E	NE	E	NE	E	NE
0	13	12	4	8	10	12	13	6
1	1	2	3	4	1	3	2	5
2	1	1	5	3	1	0	0	2
3	0	0	1	0	3	0	0	1
4	0	0	2	0	0	0	0	0
5	0	0	0	0	0	0	0	1

Note. E = Effective drawings (i.e., use correctly in the task). NE = Non-effective drawings.

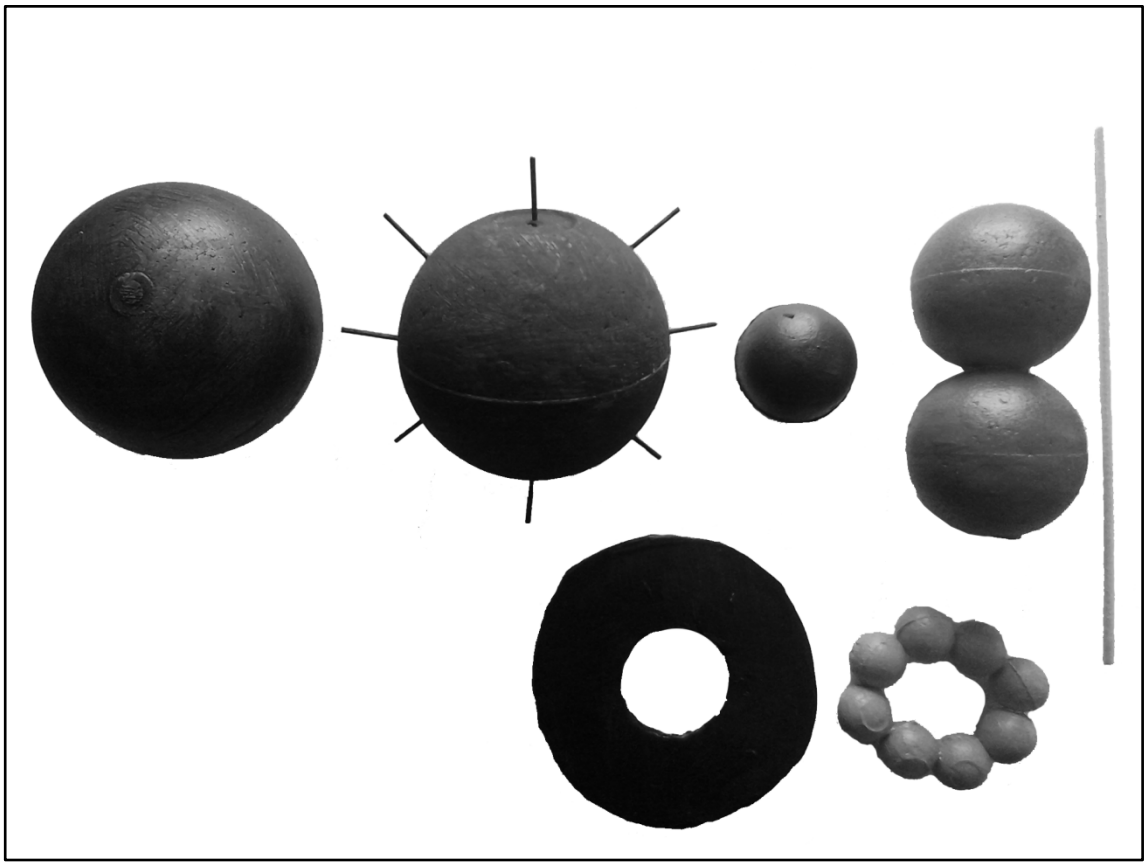

Figure 1. Objects depicted by children and distractors.

Figure 2. Samples of effectively-used pictures of Object 2 even though they were not coded as ´Shape drawings´.

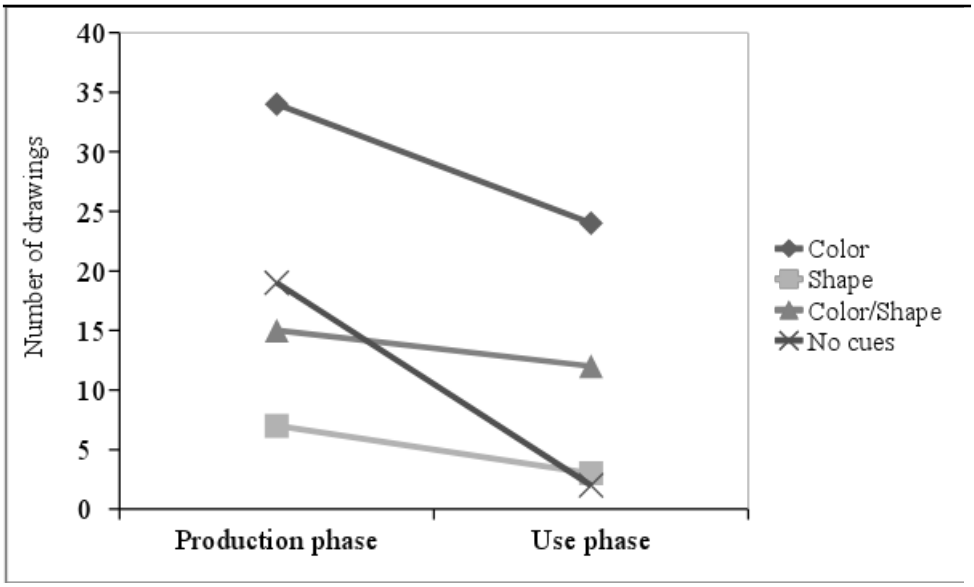

Figure 3. Children's performance on the production and use phases of the task across drawing type in Study 2.