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Traces of the artist: Sensitivity to the role of the artist in children's pictorial reasoning

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In three studies we investigated the question of whether children consider the attributes of the artist (sentience, age level, affective style, emotion) when making judgments about the traces (drawings) made by that artist. In Study 1, 2–5-year-old children were asked to find pictures drawn by a machine, an adult, an older and a younger child. Results indicated that children younger than 4 years do not consider the artists' attributes when making judgments, but 4- and 5-year-olds do. Furthermore, whereas the oldest children were adept at both machine–person (sentience) and person–person (age) contrasts, 4-year-olds succeeded only with person–person contrasts. In Study 2, videotaped artists displayed differences in degree of agitation (affective style) while drawing, and this attribute was manipulated in the drawing by varying line density, asymmetry, line overlap and line gap, or all four features, across stimuli. Three- and five-year-old children judged whether a calm or agitated person drew the stimuli. Findings showed that five-year-old, but not 3-year-old, children easily completed the task. In Study 3, 3-, 5- and 7-year-old children judged whether happy or sad artists made paintings of matching emotional tone. Performance on this picture judgment task was contrasted with performance on three theory of mind tasks (false belief, emotion and interpretative). The results indicated that 5- and 7-year-olds successfully judged the impact of artists' emotions on paintings, but 3-year-olds did not. Performance on the picture task was related to that on the false belief task, but not to the emotion or interpretive tasks. Taken together, the results suggest that children's view of visual symbols includes a consideration of the qualities of the artist beginning around 5 years, and there appears to be a common link between judgments of the mind behind the visual symbol in the picture task and judgments of mental state reasoning in the false belief task.

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Most philosophers agree that expression is one of the primary functions of art (Langer, 1953) and concur with the dominant view that there is no necessary relation between the mental state of the artist and the expression of a mental state in a particular painting (Arnheim, 1974; Goodman, 1968). The property of expression is seen to reside in the structural qualities of the symbol itself. This is a sophisticated understanding of visual symbols, that is, like Kohlberg's Stage 5 of moral reasoning, rarely found. For most children and young adults, visual symbols such as paintings and photographs are not only about objects and events in the world, they are also about the persons who produce them (Freeman, 1993a,b, 1995; Parsons, 1987). Symbolic communication has a dual function: to specify about the world out there (i.e. the referents) as well as about the mind behind the symbols (i.e. the mental state of the symbol maker). In order to understand the multiple layers of meanings in visual symbols, the child needs to hold in mind the obvious meaning of the symbol and update that with meaningful information from the visual symbol itself (e.g. colours, line quality), as well as from inferences about the mental state of the person who made the symbol (e.g. intentions, emotions, desires). At the core of this understanding is the knowledge that people create different symbols based on different communicative intentions. In this research we focus on the development of this understanding and the links between it and other forms of social cognition in early childhood.

Freeman (1995) captures the complexity of visual symbol understanding in a model suggesting that mature pictorial reasoning involves an ability to map a complex intentional network that links pictures to three components: the real or imagined world that they represent (i.e. the referent), the mind of the artist and the mind of the beholder. From this perspective, the meaning derived from a pictorial symbol may shift over development according to which aspect or aspects of the intentional network (referent, artist, beholder) are being considered by the child at that time. Although we know something about the development of children's understanding of the link between pictures and their referents, we know little about the corresponding development in their reasoning about the roles of the artist or the beholder. The research reported here is exploratory in its investigation of the development of the first of these relatively neglected aspects of the symbolic process. We ask when children begin to infer artists' states of mind from their graphic productions and how this process of inference relates to the development of theories of mind, a process that, like pictorial reasoning, involves an inference of how the mind will affect outcome. We begin with a review of what is known about the development of children's pictorial reasoning about the links between pictures and referents, beholders, and artists.

Pictures can be linked to their referents directly, as in using a photograph to indicate which of two items to choose, or indirectly as in using a photograph of student protesters to convey the idea of freedom and rebellion. Sometime around their third birthday, children are able to use pictures having a direct correspondence to referents to guide their responding in a variety of tasks (Callaghan, 1999, 2000a; DeLoache, 1991; DeLoache & Burns, 1994; DeLoache, Pierroutsakos, & Troseth, 1997; Harris, Kavanaugh, & Dowson, 1997; Thomas, Nye, & Robinson, 1994). Sometime around their fifth birthday, children are able to make judgments about the emotion portrayed in abstract paintings (Callaghan, 1997), hence deriving meaning when there is an indirect correspondence between symbol and referent, and can accomplish this at 3 years when scaffolded by an adult who models these judgments (Callaghan, 2000b). When probing the limits of this understanding of the relation between picture and referent, Thomas and his colleagues (Nye, Thomas, & Robinson, 1995; Robinson, Nye, & Thomas, 1994;

Thomas *et al.*, 1994) report that 4-year-olds have difficulty holding in mind both the object and symbolic properties of pictures, mistakenly reasoning, for example, that pictures will update and backdate to match changes made to the referent. Thus, there is considerable refinement across development of children's understanding of the relation between picture and referent.

Pillow and Henrichon (1996) and Chandler and LaLonde (1993) explore children's understanding of the link between the picture and beholder. In their tasks, children are asked to predict how a naïve observer would interpret an ambiguous pictorial feature. Typically, the task presents a sequence of covered pictures with an ambiguous feature (e.g. a triangle) displayed through cut-out windows and children are asked to make a prediction as to what the entire picture represents on each trial. On two trials the same picture is revealed (e.g. shark with triangular fin) and on the third a different picture is displayed (e.g. house with triangular roof). Children initially predict that the same picture will be revealed on the third trial and are then asked to predict what a puppet would predict with the same sequence. At around 7 years children realize that two people (themselves and the puppet) can hold different interpretations of the same input (i.e. an interpretive theory of mind) and predict that the puppet will mistakenly guess that the third picture is the same as the first two. These findings reveal both that there is refinement of children's theory of mind beyond 4–5 years, and that children's reasoning about the role of the beholder in pictorial reasoning is a relatively late developing skill.

In one of the few studies to chart children's pictorial reasoning about the role of the artist, Freeman and Sanger (1993) interviewed 7–12-year-olds about the impact of a number of factors, including the artist, on the quality of pictorial representations. The authors report that it is not until late childhood (11–14 years) that children concede that the qualities of the artist (i.e. skill, intentions, mood) could influence the quality of the trace, agreeing for example, that with a high level of skill artists could make ugly pictures of beautiful things and vice versa. These and other responses from the interviews suggest that young children believe there to be a one-to-one correspondence between picture and referent, artist or beholder, whereas older children begin to consider that the intentional relations between artist and beholder have an impact on the trace. In related research, Parsons (1987) also interviewed children and young adults about their views of the reasons that painters make paintings. Selected responses reported from these interviews also suggest that up until late adolescence, children believe that artists' moods are directly transferred onto the canvas.

Bloom and Markson (1998) report a much earlier sensitivity to artists' intentions using a naming task with 3–4-year-olds. In a series of tasks, children were asked to name either their own or another artist's drawings. The themes chosen for the child's own drawings ensured that amibiguous forms were produced (e.g. balloon, lollipop) and the drawings of others were scribbles that did not resemble their referents. For example, children may be told that another child made a picture of a horse and a spider and presented with a large and a small scribble. Children typically named the large scribble 'horse' and the smaller one 'spider'. The findings suggested that in spite of the lack of shape similarity between picture and referent, children were successful in naming the pictures and appeared to rely on their own or another artist's intentions when making their judgments. In a related study, however, Browne and Wooley (2001) report that if the intentions of the artist conflict with graphic resemblance (e.g. the artists announces he will draw a bear and the picture resembles a rabbit), then participants (4- and 7-year-olds, adults) rely on resemblance rather than intentions when naming the picture. The

tendency to rely on intentions when naming pictures was stronger when ambiguous pictures (e.g. drawings rated to look like a bear by half the participants and a rabbit by the other half) were used, but only for 7-year-olds and adults, not for 4-year-olds. Taken together, the findings from these two studies suggest that by 3 years of age children will use intentions of the artist as a cue to name the picture when there are no other conflicting cues, but even adults fail to use intentions as a cue when the name cued by intentions directly conflicts with the name cued by resemblance.

Although not explicitly instructed to attend to artists' intentions, children in Callaghan's (1997) study may have done so in their judgments of the emotional tone portrayed in paintings. To highlight the target emotion in these studies, children were initially presented with photographs of an actress displaying four emotions during instructions and then each target photo was on display as the child made their choices. The findings indicated that children were able to make judgments of the emotions portrayed sometime around their fifth birthday, even though the relation between picture and referent was indirect. In a second study with preschoolers (Callaghan, 2000b), children were asked to find paintings that teddies, who were made to look happy, sad, excited or calm, would choose for their house. When teddies first modelled appropriate choices children correctly judged the emotion portrayed in novel paintings at 3 years. Other researchers, who do not highlight the emotions of the artists in their instructions, do not typically report success on these tasks until 7–10 years (Jolley & Thomas, 1994; Winner, Blank, Massey, & Gardner, 1983). In hindsight, using photographs of the artists as props in Callaghan's studies may have led children to consider the relations between a person's (or teddy's) emotional state and the paintings. This, in addition to attending to the structural properties of the symbol itself (e.g. colour, line, compostion), may account for children's relatively early success on the task. In the current studies we explicitly instruct children to judge paintings on the basis of attributes of the artists' mental states.

In summary, studies investigating children's sensitivity to how attributes of the artist (e.g. intentions, emotions) have an impact on pictures vary in their estimates of the onset of this ability. Variability may be due to different task demands. In Freeman and Sanger's (1993) and Parsons' (1987) studies children revealed their understanding in verbal responses to interview questions. It is possible that interviews may only reveal children's explicit knowledge of the factors influencing picture quality, knowledge that Karmiloff-Smith (1992) has argued emerges relatively late in development. Thus, interviews may underestimate children's understanding. Bloom and Markson's (1998) task was a forced choice task requiring children to associate names for large and small referents (e.g. horse, spider) to large and small scribbles. Callaghan's (2000b) study provided models of correct choices. Forced choice and modelling tasks may overestimate children's understanding. The developmental story needs to be investigated further, especially as it relates to the onset and refinement of children's understanding of the mind behind the symbol. We address this need in the current research.

On the surface, developing an understanding that pictures are intentional products of artists' minds would seem to be related to developing an understanding that behaviours are intentional products of actors' minds (i.e. theories of mind) because both involve an inference about how mind will affect outcome (behaviour or picture). Initially, a simple theory of mind (or pictures) would predict a one-to-one correspondence between beliefs, desires, knowledge or emotions of an actor (or artist) and their behaviours (or pictures), as when 4–6-year-old children predict that a

puppet will look in the cupboard where they falsely believe the chocolate to be (Perner, Leekham, & Wimmer, 1987; Wimmer & Perner, 1983), or will feel happy before they discover the coke has been replaced by milk (Harris, 1983, 1989). Later, a more sophisticated theory of mind (or pictures) will allow that more complex intentional relations are at play, as when 7–10-year-olds acknowledge that actors may hide how they really feel (Gross & Harris, 1988; Harris, 1989; Harris, Johnson, Hutton, Andrews, & Cooke, 1989), or that two people could have different interpretations of the same visual (Chandler & LaLonde, 1996; Pillow & Henrichon, 1996) or emotional (Harris, 1983) input. Whereas the developmental trajectory for theory of mind is well documented in the context of an understanding of the consequences of actors' beliefs, desires and emotions on their behaviours, very little is known about the corresponding development in the context of an understanding of artists and their pictures. We address this lack in the current series of studies. In particular, we focused on the question of how children's understanding that pictures are intentional manifestations of artists' minds develops. This research extends the efforts of Freeman (1993a,b, 1995; Freeman & Sanger, 1993), Parsons (1987) and others (Bloom & Markson, 1998; Browne & Wooley, 2001) by employing behavioural (classification) rather than verbally based interview and naming tasks.

The task used in the current studies to tap children's understanding of the mental state behind the symbol involved presenting children between the ages of 3 and 7 years with series of pictures that were drawn by particular artists (e.g. young or old, agitated or calm, happy or sad). Children were sometimes asked to judge which of two artists made the drawing, and other times asked to match one artist to one of two drawings. Based on Callaghan's findings (1997, 2000b) for judgments of emotion portrayed in museum art, we assumed that children come to this task with knowledge that distinct mental states (e.g. emotions) can be portrayed in pictures. To complete the task used in the current studies, however, children also required a sense that the person who made the symbol may also have left a trace of his/her mental state in the symbol. When presented with a photograph and a brief description of the artist, children were asked to make an inference as to how the artists' mental state would affect the marks on the drawing or painting. Given the propensity for children to construe a direct mapping between artists' mental states and the mental states expressed in paintings (Freeman, 1993a,b; Parsons, 1987), this question would seem a natural one, at least for our older children (7 years old). To our knowledge, outside the interview studies mentioned, there have been no other studies that directly ask children to reason about how the mental state of the artist would affect the symbol (i.e. painting, drawing, photograph) that they produce, and none that explore this reasoning in preschool-aged children.

We explore the development of this reasoning in Studies 1 and 2. Study 1 framed the question in the context of two attributes of the artist: age (i.e. drawings by people of different ages) and sentience (i.e. drawings by people vs. machine). Children were presented with drawings and told a young child, an older child, an adult or a machine made them. They were asked to find one drawing in a pair that was made by each of these kinds of artists. Study 2 asked children to make judgments of drawings made by artists who were videotaped as they drew in either an agitated or calm manner. Once again, the task was for the child to match one drawing with its artist. Finally, Study 3 assessed children's judgments of artists' emotions and their effect on paintings, as well as investigated the connection between these judgments and the ability to infer the mental states of others in well documented theory of mind tasks. Performance on a visual symbol task, in which we asked children to match happy and sad pictures with

artists depicted with matching feelings, was compared to the performance of the same children on three theory of mind tasks: a false belief task, a false emotional expression task and an interpretative theory of mind task. In general, the rationale of Study 3 was to enlarge the topic of visual symbol understanding by identifying links between this understanding and theories of mind in order to help us to capture more accurately the nature of children's developing picture understanding, particularly, the construal of who is behind a visual symbol.

Based on the existing literature of developing theories of mind and pictorial reasoning, we predicted that between 4 and 5 years of age children would begin to show signs of understanding that specific visual representations reflect the artist's mind and not only the referent. We anticipated that initially children would construe a one-to-one correspondence between attributes of the artist and quality of the trace, and later would entertain more complex intentional relations. Finally, we hypothesized that a correlation between such understanding and success on some, if not all, of the theories of mind tests would be found.

STUDY 1

In this study children were asked to make judgments of pictures drawn by four artists; a young child (4 years), an older child (10 years), an adult and a machine (computer printer). Age of the artists and sentience varied across conditions. In this first study in the series, our aim was to explore whether children showed any consideration of the attributes of the artist when making these judgments. Based on findings from Callaghan (1997, 2000b), who asked children to make judgments of the emotion portrayed in museum art, and the abundant evidence that children engage in causal mental state reasoning by 5 years of age (Perner, 1991), we expected that children would begin to make these judgments at 5 years.

Method

Participants

Four age groups of 16 children were tested ($N = 64$). These groups were 2 years ($M = 31.9$ months, range = 27–35 months), 3 years ($M = 41.8$ months, range = 36–47 months), 4 years ($M = 52.6$ months, range = 48–56 months) and 5 years ($M = 63.1$ months, range = 60–68 months) of age. Children from predominantly white and middle class families were tested in a quiet room in their home or daycare centre. Each received a small present for their participation. Parents who were present during the experiment were asked not to interact with their children, and all complied with this request.

Stimuli

There were four stimulus sets constructed for this experiment by a machine (computer using MacDraw), an adult, an older child (11 years) and a younger child (4 years). Each set consisted of the drawings by a particular artist of eight different objects: a lollipop, a tree, a cup and saucer, balloons, a bear, a cube, a bird and a house. Sample drawings of

the bear from each of the four sets are presented in Fig. 1. All drawings were simple black-and-white line drawings with identical line thickness. They were initially drawn on plain white printer paper and then photocopied onto uniformly sized white cover stock paper (4 × 4 m.). The size of the drawing was adjusted in the photocopying process to ensure that all drawings were uniform in size, covering approximately half of the card.

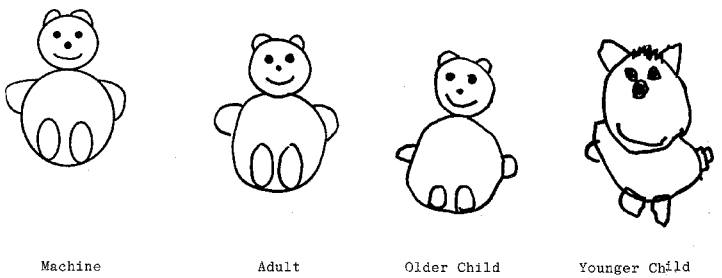

Figure 1. Sample drawings used in Study 1.

Procedure

Children were first instructed that they were going to play a game with some pictures and that their job in the game was to find the pictures that different artists had made. Following these general instructions, children were presented with the 'drawing machine', which was an old, noisy Panasonic KX-P1180 multi-mode printer. They were told, 'This is a very special drawing machine. It can make pictures. I'll show you how it does this.' E then proceeded to show the child how the machine made its pictures by inserting a piece of paper, lifting the top paper guard to obscure the view of what was printing, and then turning on the printer to partially print a test page. Thus, the child was told a story that this was a special 'drawing machine' and was presented with sufficient noise to lead them to expect that a drawing was being produced, but were not presented with the finished drawing.

Once the drawing machine had been introduced, it was put away and four photographs, corresponding to each of the four artists (machine, adult, older child, younger child), were presented. All human artists were male. The artists were introduced as the drawing machine, the grown up Dad, the big brother and the little brother. Children were told that each of these artists had made pictures that would be used in the game. Following this, all but one photograph was removed and the child was instructed to find the pictures made by the highlighted artist using the following instructions. 'We're going to start by finding all the pictures that (e.g.) the little brother made. Some of the pictures will be made by (e.g.) the grown up Dad, but I want you to find *just* the pictures made by the little brother, OK?' Then the child was presented with eight pairs of pictures, one pair for each of the eight objects. One member of the pair was the target and drawn by the artist in the highlighted photograph, and the other member of the pair was the non-target and drawn by one of the other artists. Both pictures in the pair depicted the same object on a given trial, and different objects were portrayed across the eight trials of a block.

There were a total of six blocks of eight trials, corresponding to the contrasts of machine–adult (MA), machine–older child (MO), machine–younger child (MY), adult–older child (AO), adult–younger child (AY) and older–younger child (OY) drawings. The order of blocks was counterbalanced across participants within the following guidelines. Half of the children received the three blocks for the pairings of machine with person (MA, MO, MY) first, and the three blocks for the pairings of person with person (AO, AY, OY) second. The remaining half received the reverse order. Four orders for the presentation of the three blocks were randomly chosen from all possible orders and assigned in counterbalanced fashion to four children in each of the age groups. Whether the children were asked to look for the machine or person in machine–person pairings, or the adult or older or younger child in the person–person pairings was counterbalanced across participants. In an effort to reduce position perserveration, the position of the correct picture was randomized across the eight trials within a block, with the restriction that the correct picture was not presented in the same position for more than two consecutive trials. The entire session, comprising 48 trials arranged in 6 blocks of 8, lasted approximately 15 minutes.

Results and discussion

Children in four age groups (2, 3, 4, 5 years) were presented with six types of contrasts, three that differed in sentience of the artist (MA, MO, MY), and three that differed in age level (AO, AY, OY). The mean numbers of correct choices are presented in Table 1. We first determined whether children were performing above chance levels. To do this we subjected the number of correct choices (of eight) to one-way ANOVAs at each age level with six contrasts (MA, MO, MY, AO, AY, OY) as the experimental factor, and used the least significant difference (LSD) test (Kirk, 1968) to determine whether performance was significantly above chance (i.e. 4 of 8). Two-and three-year-old children were not performing significantly above chance with any of the pairings, and all contrasts were equivalent within each age (all Fs < 1) for these ages. Four-year-olds were significantly above chance ($p < .05$) only for the person–person pairs (AO, AY, OY), which were equivalent, but not for any of the machine person pairings. Five-year-

Table 1. Mean number of correct choices in Study 1 as a function of age and type of contrast

		Type of contrast						
Age		MA	MO	MY	AO	AY	OY	*M*
2 years	*M*	3.63	4.13	4.31	4.44	4.00	4.38	4.15
	SD	1.08	1.31	1.20	1.31	1.45	1.59	
3 years	*M*	4.43	3.63	4.44	3.75	4.13	4.38	4.13
	SD	1.50	1.15	1.55	1.53	2.13	1.96	
4 years	*M*	4.00	4.38	4.63	5.69	5.13	5.00	4.80
	SD	1.97	2.82	3.10	1.54	2.60	2.88	
5 years	*M*	4.88	5.63	5.81	5.63	5.69	5.50	5.49
	SD	2.00	2.90	3.08	2.13	2.96	3.10	
	M	4.19	4.44	4.80	4.88	4.73	4.81	

olds were at chance for the MA contrast only, presumably the most difficult among all the contrasts, and above chance ($p < .05$) for all others.

These findings were mirrored in the overall ANOVA that used a 4 Age × 6 Contrast design. There was a marginally significant trend for Age, $F(3, 60) = 2.33$, $p < .08$, and a significant Contrast effect, $F(5, 300) = 2.24$, $p < .05$. Tukey's test of the marginal age effect indicated that 2- and 3-year-olds were equivalent and less good ($p < .05$) than 4- and 5-year-olds, who were comparable in their overall performance. The Age effect was likely not robust due to a number of children in the older age groups (three 4-year-olds and four 5-year-olds) whose choice patterns were opposite to what we instructed (e.g. reliably chose the young child's picture when asked to chose the adult's). This led to very low numbers of correct choices for these children and significantly pulled the group averages down. Only two 3-year-olds and no 2-year-olds showed this pattern. Rather, the tendency for these children was to perseverate on position, leading to levels of performance close to chance in most individuals. Tukey's tests of the Contrast effect indicated that the MA and MO contrasts were equally difficult. Only the MA contrasts were significantly different ($p < .01$) from the remaining contrasts (MY, AO, AY, OY), and these were equivalent.

These findings suggest that children younger than 4 years do not reliably choose pictures on the basis of either sentience or age level of the artist. By 4 years, children begin to do well when asked to make judgments of age level in person–person contrasts, but not when asked to distinguish on the basis of sentience in machine–person contrasts. Five-year-olds do well either with sentience or age level with one exception, the most difficult contrast of machine to adult (MA). Perhaps these children construe that adults and machines are of equal drawing skill level. Support for this was found when some of the children expressed the opinion that you can tell a machine or adult did the drawing because it was more precise and accurate. In contrast, children would sometimes point to a spot on the drawing where there was a gap in the line or an overlap of lines when supporting a claim that they knew a child had done a drawing. However, as we did not systematically record rationale for choices from all children, or manipulate the perceptual features of the drawings, we cannot be certain that all children reasoned in the same way. In the next study we did systematically manipulate the perceptual features that varied within drawing pairs, and to extend the findings of Study 1, we asked children to judge drawings on the basis of a different attribute of the artist, affective style (i.e. calm or agitated). The goal was to explore further children's ability to detect and differentiate idiosyncratic traces left by artists in their graphic productions, and to identify the stimulus features used to make judgments of this sort.

STUDY 2

In this study we extended the range of artists' attributes investigated to include affective style (agitated vs. calm), and manipulated the perceptual features (line density, asymmetry, line overlap, line gap) used to ensure the drawing portrayed an agitated vs. calm style. Children were presented with video clips of artists having a dynamic/agitated or a serene/calm mood while working on a drawing, but were not able to see the actual production of these artists. They were then asked to judge which artist made the drawings that were subsequently presented. This study allowed for exploration of the generalizability of the phenomenon reported in Study 1 to a new attribute of the

artist, mood or affective style, and for specification of the visual features children use to make these judgments.

Prior to choosing the stimuli for this study we conducted a pilot study with 42 adults to ensure that the drawings categorized by the experimenters as those of the 'calm' or 'agitated' artist were indeed judged to be so by naïve adults. The stimuli used in the pilot study were drawn by one of the experimenters, who first drew nine objects while simulating a calm mood and then drew the same objects while simulating an agitated mood. The drawings were then compared by both experimenters and four perceptual features (line density, asymmetry, line overlap and line gap) that clearly differentiated between the two types of drawings in all nine cases were identified. An inspection of Fig. 2 attests to the primacy of these perceptual features in differentiating the baseline calm and agitated drawings. Following this, the first experimenter then completed the sets of drawings by adding relatively agitated drawings that varied only one of these perceptual features when compared with the calm baseline drawing. Thus, for each of the nine sets, there was a calm baseline, an agitated baseline (all four features varied compared to the calm) and four relatively agitated exemplar drawings (only one feature varied per drawing), for a total of six drawings per set.

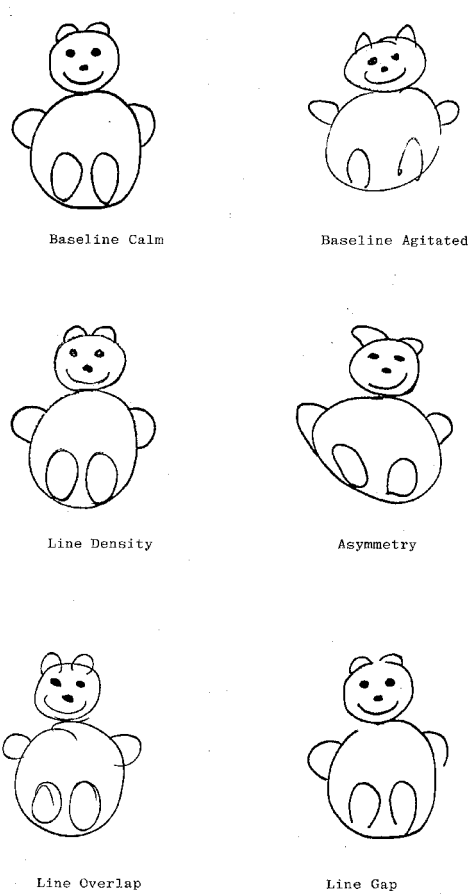

Figure 2. Sample drawings used in Study 2.

In the pilot study, adults were presented with pictures from these nine sets one at a time and asked to indicate on a line directly below the drawing to what degree the drawing appeared to be drawn by a relatively calm/agitated person. Agitated was defined for judges as 'highly agitated or excitable' and the painting movements of both calm and agitated styles were demonstrated. The line was labelled as Calm at one end and Agitated at the other and the judges crossed over the line to indicate how calm/agitated he or she believed the drawing to be. The length of the line was measured for each stimulus and these data were subjected to analyses of variance to determine which factors affected adults' judgments, and where there was most agreement in the pattern of judgments across adults in their choices. The analyses confirmed that for six of the nine sets of drawings the calm baseline drawings were rated as most calm (mean line length = 14 mm) and the agitated baseline drawings as most agitated (mean line length = 53 mm). The drawings that varied only one perceptual feature ranged in between these two (mean line length = 22 mm for line density, 32 mm for line gap, 38 mm for asymmetry and 46 mm for line overlap). For use in the study with children, we randomly chose four sets from the six sets that showed a consistent pattern across adults' judgements. To our knowledge there have been no studies that have asked children to make judgements on the basis of perceptual differences such as the ones manipulated in these stimuli, thus it is difficult to make precise developmental predictions regarding the effectiveness of these specific perceptual features in mediating judgments about the artist's mood or drawing style. However, given that children were able to judge the age and sentience of artists around the age of 5 years in Study 1, we expected that they would also be successful in judging mood at the same age.

Method

Participants

A total of 32 children, 16 at each of the ages of 3 years (M = 43.3 months, range = 36–47 months), and 5 years (M = 61.4 months, range = 60–65 months) participated in this experiment. Children were predominantly from white, middle class families. They were tested in a quiet room in their home or daycare centre and received a small present for their participation. When parents were present during the experiment, they were asked not to interact with their children, and all complied with this request.

Stimuli

To highlight the artists' drawing style, children were presented with short video clips of adults drawing with either a very calm, serene style or a highly charged, agitated style. The actresses drew on an easel in a position where their body movements were highly visible but where the drawing was not. They were filmed individually.

All drawing stimuli were simple black-and-white line drawings photocopied onto white cover stock (4 × 4 in.). Drawings were of equivalent line thickness and size, covering approximately half of the card. As stated, the four features that were individually manipulated in the relatively agitated drawings (i.e. compared with baseline calm drawings) included line density, asymmetry, line overlap and line gap. We also manipulated all four features to produce a baseline-agitated type. Thus, this resulted in

six types of drawings; baseline calm, baseline agitated, and the four relatively agitated drawings (line density, asymmetry, line overlap and line gap). There are nine non-overlapping types of contrasts that can be made by pairing these stimuli so that either all four or only one feature differs across the pair. Four features differed across the pair only when the baseline calm drawing was paired with baseline agitated (CAG) drawing. Single features differed in all other contrasts. For half of these contrasts, the baseline calm drawing was paired with a relatively agitated drawing that differed in either line density (CLD), asymmetry (CAS), line overlap (CLO) or line gap (CLG) across the pair. For these contrasts the correct choice was the calm drawing when children were looking for calm, and the agitated drawing when children were looking for agitated. For the remaining half, a baseline agitated was paired with a relatively agitated drawing that differed in line density (AGLD), asymmetry (AGAS), line overlap (AGLO) or line gap (AGLG). For these contrasts, the correct choice was the less agitated of the pair when looking for calm and the more agitated when looking for agitated. These nine sets thus comprise five where a calm drawing is paired with an agitated one (subsequently referred to as CalmAgit), and four where two agitated drawings are contrasted (AgitAgit). Sample drawings of these types are presented in Fig. 2.

Procedure

Children were tested individually on two successive days to avoid fatigue. They were first oriented to the task by E, who said they were going to play a game with some pictures and that their job in this game was to find the pictures that were made by two different people. Then children were shown the video clip of one of the artists, followed by the other, as E remarked, ''Look at (Susie or Annie), see how she is drawing? She is really ('calm' or 'excited and crazy') when she draws isn't she? I wonder what her drawings look like.'' E then paused while the child watched the video for approximately 30 seconds, and said, 'Let's look at our other artist and see how she draws.' Then E presented the second video clip using the same commentary. Following this short introduction to both artists' mood and affective style, E represented the video clip of the artist whose drawings the child was to find for that day (see below). All children looked for both Calm and Agitated drawings in counterbalanced order across two days of testing.

Within each day of testing, children were presented with both CalmAgit and AgitAgit pairings. In the CalmAgit group there were drawings of four objects for each of five contrasts yielding a deck of twenty pairs of cards that were presented in random order. For the AgitAgit group there were also four drawings, but this time of four contrasts, yielding a deck of sixteen pairs of cards that were randomly ordered. On any given day, the child was looking for only one type of drawing, either calm or agitated, depending on the artist that had been highlighted in the instructions. Note that when the child was looking for a drawing in the CalmAgit group, there was always a drawing in the pair that was not calm, or not agitated. When looking for a drawing in the AgitAgit group, they were forced to make a relative judgment because there was no baseline calm drawing; both were agitated. Position of the correct choice was randomized with the restriction that it not appear on the same side for more than two consecutive trials. Each of the two daily sessions lasted approximately 15 minutes.

Results and discussion

Children at two age levels (3, 5 years) were asked to find drawings made by artists having two affective styles (Calm, Agitated) when presented with pictures that paired calm with agitated drawings (CalmAgit) or agitated with agitated drawings (AgitAgit), and that varied four features (line density, asymmetry, line overlap, line gap), either singly or all together, to stand for more or less agitation. Type of object drawn effects and order effects were first examined by subjecting proportion of correct choices to one-way ANOVAs. Neither ANOVA revealed any significant effects on performance (all Fs < 1). We then determined whether children were performing above chance, and examined the relative effects of experimental variables as outlined below.

Emotion and pairing effects

The mean proportion of correct choices, averaged over the type of feature contrast and type of drawn object, was calculated for each child for the CalmAgit and AgitAgit pairings, both when they were looking for the drawings produced by the calm and by the agitated artists. These data were subjected to a 2 (Age) × 2 (Emotion) × 2 (Pairing) repeated measures ANOVA. A LSD test was used to determine whether performance was significantly different from chance. Three-year-olds were not performing above chance (.50) in any of the four conditions, whereas five-year-olds were well above chance in all conditions. This age effect was confirmed by the pattern of effects found in the ANOVA. Significant Age, $F(1, 30) = 163.68$, $p < .001$, Emotion, $F(1, 30) = 6.35$, $p < .02$ and Pairing, $F(1, 30) = 10.50$, $p < .003$, main effects were found. These must be interpreted in light of the interactions of Age × Pairing, $F(1, 30) = 12.38$, $p < .001$ and Emotion × Pairing, $F(1, 30) = 7.00$, $p < .01$. Simple effects tests of the Age × Pairing interaction showed that CalmAgit pairings were easier $p < .01$) than AgitAgit pairings but only for the 5-year-olds (.93 vs. .79, respectively). There was no pairing effect for 3-year-olds (.49 vs. .50). Simple effects tests of the Emotion × Pairing interaction indicated that one condition resulted in poor performance relative to the rest. When children were looking for drawings of the agitated artist in AgitAgit pairings, they performed poorly (.58) relative to when they were looking for those in CalmAgit pairings (.70), $p<.01$, or looking for Calm drawings in either pairing (.73 and .71 for CalmAgit and AgitAgit, respectively).

Table 2. Mean proportion of correct choices in Study 2 as a function of age, pairing and emotion

		Emotion				
		Calm		Agitated		
Age		CalmAgit	AgitAgit	CalmAgit	AgitAgit	*M*
3 years	*M*	.53	.57	.46	.43	.50
	SD	.16	.17	.19	.13	
5 years	*M*	.94	.84	.93	.74	.86
	SD	.07	.08	.13	.18	
	M	.73	.71	.70	.58	

These results suggest that children who are younger than 5 years apparently do not interpret drawings in terms of the inferred impact of affective style of the artist on the subsequent drawing, whereas 5-year-olds accomplish this task with ease. The results also indicate that the judgments made by the older children are affected by two factors; the emotion they are looking for (calm, agitated) and whether the judgment is an absolute (CalmAgit) or relative (AgitAgit) one. Whereas looking for agitated is more difficult overall than looking for calm, and relative judgments are more difficult overall than absolute, performance does not seriously deteriorate until both of these factors are operating, as in looking for agitated drawings in AgitAgit pairs.

Feature effects

In order to determine which features children associate with drawings produced by an agitated artist, we calculated the number of correct choices (of a total of four) for each feature contrast (CAG, CLD, CAS, CLO, CLG, AGLD, AGAS, AGLO, AGLG) and separately analyzed the data for CalmAgit and AgitAgit pairings. The means relevant to these analyses are presented in Table 3.

Table 3. Mean number of correct choices (of a total of 4) in Study 2 as a function of age, emotion and type of feature contrast, for CalmAgit and AgitAgit pairings

			Feature contrast					
Age	Emotion		All	Density	Asymm	Overlap	Gap	*M*
CalmAgit								
3 years	Calm	*M*	**2.4**	**2.3**	**1.6**	**1.9**	**2.4**	**2.1**
		SD	1.2	1.4	0.5	1.1	1.3	
	Agitated	*M*	**1.6**	**1.9**	**1.9**	**2.3**	**1.6**	**1.8**
		SD	1.4	1.3	0.9	1.1	1.4	
5 years	Calm	*M*	**4.0**	**3.9**	**3.6**	**3.9**	**3.4**	**3.8**
		SD	0.0	0.3	0.6	0.3	0.6	
	Agitated	*M*	**3.9**	**2.9**	**3.6**	**3.8**	**3.5**	**3.7**
		SD	0.3	0.4	0.6	0.4	0.6	
AgitAgit								
3 years		*M*	**2.0**	**2.3**	**1.9**	**1.8**	**2.0**	
		SD	0.9	1.3	1.1	0.9		
5 years		*M*	**3.0**	**3.1**	**2.9**	**3.5**	**3.1**	
		SD	1.2	0.8	0.9	0.8		

For CalmAgit pairings, a 2 Ages × 2 Emotion × 5 Feature Contrast repeated measures ANOVA was performed. The ANOVA revealed significant Age, $F(1, 30) = 254.67$, $p < .001$, and Feature Contrast, $F(4, 120) = 2.69$, $p < .03$, main effects. The age effect indicated that 3-year-olds (1.98) performed significantly more poorly than 5-year-olds (3.74). LSD tests confirmed that 3-year-olds were at chance for all contrasts and both emotions, whereas 5-year-olds were above chance in all conditions ($p < .05$). *A posteriori* analyses of the Feature Contrast effect showed that for contrasts in which the Calm baseline was contrasted with line density or overlap, or with an Agitated baseline, performance was equivalent and at the highest level. When the Calm

baseline was contrasted with line gap, performance was poorest. Performance was at an intermediate level when the Calm baseline was contrasted with asymmetry in this overall ANOVA, however, when 5-year-olds' data were analysed separately, the asymmetry contrast were at the same level as line gap contrasts.

Thus, it was easy for children to discriminate between the two drawings of a pair when all four features differed, as well as when line density or line overlap alone differed. In contrast, line gap and asymmetry alone were not enough to help children find the calm or agitated pictures in these pairings. These results suggests that line gap and asymmetry are not features that children associate with drawings of an agitated person, but line overlap and line density are. Note that these findings held regardless of whether the child was looking for Calm or Agitated drawings.

For AgitAgit pairings (see Table 3), a 2 Ages × 2 Emotion × 4 Feature Contrast repeated measures ANOVA was performed. The ANOVA revealed significant Age, $F(1, 30) = 48.47$, $p < .001$ and Emotion, $F(1, 30) = 12.01$, $p < .002$, main effects, and an interaction of Age × Feature Contrast, $F(3, 90) = 2.78$, $p < .05$. The age effect showed that 3-year-olds (2.01) were performing less well than 5-year-olds (3.14). LSD tests indicated that the performance was at chance for all types of contrasts for 3-year-olds, and above chance for all contrasts for 5-year-olds ($p < .01$). The emotion effect indicated that looking for calm (2.83) was easier overall than looking for agitated (2.32). Simple effects tests of the interaction showed that the feature contrast effect held only for 5-year-olds. Tukey's LSD tests indicated that when drawings were contrasted by the line gap feature, performance was best ($p < .05$), and all other feature contrasts resulted in equivalent performance.

These findings suggest that when presented with the task of choosing the calm or agitated drawing in pairs in which there is one highly agitated and a second relatively agitated drawing (AgitAgit), 5-year-olds find line gap the best feature to tune into, but can also do the task by tuning into any of the others. This reinforces the results found for CalmAgit pairs, which indicated that children do not tune into line gap when making the discrimination between the calm baseline and relatively agitated drawings. In the AgitAgit pairs, asymmetry seemed to cluster with the features line overlap and line density, but not with line gap. In the CalmAgit pairings discussed above, the anchor calm baseline did not have an asymmetric form or line gaps, and so in that context asymmetry and line gap were apparently accepted as calm features. Thus, regardless of context (CalmAgit or AgitAgit) line gap appears to be accepted as a feature of drawings made by a calm person, and line density and overlap are considered to be features of an agitated person's drawing. The feature of asymmetry flip flops; if it is seen in the context of a calm baseline it is accepted as a calm feature, but if seen in the context of an agitated baseline, it is assigned as a feature of an agitated drawing.

Overall, the results of this second study are consistent with the findings of Study 1. By 5 years, children begin to be capable of mapping graphic productions to the mind of the artist. Five-year-olds are capable of attributing drawings to artists based on particular, or clusters of, features of the drawing, but not others. Furthermore, the research demonstrates that particular features appear to stand for particular affective styles and moods of the artists (e.g. line gap signals calm, whereas line density and overlap signal agitated). Five-year-olds, like adults, pick up on those pictorial features to make sense of the person behind the artistic production.

STUDY 3

In the final study we extended our investigation of children's judgments of how mental states of the artist affect the symbol in two ways: (i) We asked whether children can make judgments of how the emotions of artists may be revealed in paintings. Whereas earlier studies have explored children's appreciation for the emotion expressed in paintings (Callaghan, 1997, 2000b), in Study 3 we explicitly asked children to match the emotion expressed in paintings with the emotion felt by the artist. (ii) We compared children's performance on a picture judgment task with that in three classic theory of mind tasks that required different levels of sophistication in mental state reasoning. We did this in an effort to assess whether the mental state reasoning required in judging the mind behind the picture is similar to any particular level that is invoked when judging the mind behind the behaviour.

As noted earlier, although the expression and appreciation of emotion in art is seen as central to full aesthetic experience (Gardner, 1973; Langer, 1953; Winner, 1982), most estimates of the age of onset of this appreciation claim that it is not until relatively late in childhood that emotions expressed in art are judged accurately (Carothers & Gardner, 1979; Parsons, 1987; Winner, Rosenblatt, Windmeuller, Davidson, & Gardner, 1986). Recent work challenges this claim and finds that when a matching task is used 5-year-old children's judgments of emotion resemble those of adults (Callaghan, 1997), and when an adult models appropriate choices even 3-year-olds judge the emotion expressed in paintings (Callaghan, 2000b). What has not yet been investigated in depth is whether children make judgments about how the emotions of an artist may, or may not, be expressed in a painting, although from their interviews with children, Parsons (1987) and Freeman (1993b) claim this is also a relatively late developing ability.

Goodman's (1968) claim that emotions are expressed metaphorically in paintings and as such belong to the symbol and not the artist reveals a sophisticated level of aesthetic understanding that has undoubtedly developed from a more simplistic appreciation. In their interview studies, both Freeman (1993b) and Parsons (1987) note that young children typically believe there to be a one-to-one correspondence between picture and referent, artist or beholder. Thus, a painting of an angry scene would be angry, a sad artist would make a sad painting, and a happy viewer would see all paintings as happy. What we probe in Study 3 is the development of children's construal of the link between the artist's emotion and the emotion portrayed in the artist's work using a judgment task in addition to interview questions.

In the picture judgment task children were presented with photos of two artists, one expressing a happy and the other a sad emotional state. They were then asked to judge which artist painted what painting in a set of 12. The happy and sad emotions were chosen because they contrast the valence (pleasure/displeasure) dimension of the emotion, which has been found to be discriminated at an earlier age than degree of arousal dimension (Callaghan, 1997; Russell & Bullock, 1985). A pilot study of 15 artists was conducted in order to determine which paintings in a set of 64 representative of 4 emotions (happy, sad, calm and excited) had the highest level of agreement. The entire set of postcards of museum art were presented to artists who were asked to judge which category the painting fell into as well as to rank on a 10-point scale how well the painting expressed the emotion they had chosen. All 64 stimuli were ranked at 8 or above on the rating scale by all artists, revealing that they could confidently categorize the stimuli into the categories provided. The percent of agreement among artists on categories was then calculated and 6 stimuli with highest agreement for each of the

happy and sad emotions were chosen for use in Study 3. The stimuli chosen for the happy set averaged 77% agreement (range = 67–93%), and those for the sad set averaged 83% (range = 73–93%).

We expected to find that children were able to make judgments of the artist behind the picture at the same time that they make judgments of the emotion portrayed in the picture: around the age of 5 years (Callaghan, 1997). In addition to the picture judgment task, children were tested in three classic theory of mind tasks chosen because they require increasingly sophisticated mental state reasoning as outlined in the general introduction: crayon false belief (Perner *et al.*, 1987), emotion false belief (Gross & Harris, 1988) and interpretive theory of mind (Pillow & Henrichon, 1996). Four to five-year-olds typically pass the crayon task (Perner *et al.*, 1987), and 6-year-olds usually pass the emotion and interpretive tasks (Gross & Harris, 1988; Pillow & Henrichon, 1996). To gather developmental data that would allow us to calculate correlation between success on the picture and theory of mind tasks, groups of 3-, 5- and 7-year-olds were tested on all tasks.

Based on the existing literature and the results obtained in the preceding two studies, it was expected that 3-year-old children would fail all theory of mind tasks as well as the picture task. We further predicted that the trend toward success in the picture task by 5-year-olds should correlate with their success on the crayon false belief task, but not the emotion false belief task, the latter expected to be passed successfully by the majority of 7-year-olds only. The rationale for the latter prediction is that the emotion false belief task, in comparison with the crayon false belief task, requires an additional decoupling between the perceived and its referent (see task description in the method below). In general, we expected that reasoning about the artist behind a graphic production should correlate with the levels of mental reasoning indexed by the various theory of mind tasks. If children have a more sophisticated form of mental reasoning in the theory of mind tasks, they should also have more sophisticated reasoning about paintings. Because it would be difficult to assess the limits of children's understanding of the complexity of the relationship between artist and product in the simple two-choice picture task, we also included a brief interview based on Freeman and Sanger (1993), which probed more deeply children's understanding. We expected that children who showed an understanding of the subjective mind, as indexed by the emotion false belief and interpretive theory of mind tasks (Gross & Harris, 1988; Pillow & Henrichon, 1996), would also hold the view that the relation between mental state of the artist and mental state portrayed in the painting does not have to be a matching, one-to-one relation.

Participants

A total of 36 children, 12 in each of three age groups, 3 years (M = 36.9 months, range = 34–43 month), 5 years (M = 63.1 months, range = 58–67 months) and 7 years (M = 85.8 months, range = 80–92 months), participated in this experiment. Children were predominantly from white middle class families, recruited from daycare centres and through telephone calls to parents who had previously indicated their willingness to participate in research. Children were tested individually in a quiet room in their daycare centre or in the laboratory. Two additional 3-year-olds were excluded from data analysis because they were absent on the second day of testing.

Materials and procedure

General

Children participated in a total of five tasks (picture, crayon, emotion, interpretive, interview). The picture task was always conducted first, the order of the theory of mind tasks was randomized across children, and the interview was always completed last. Children were tested over two days in sessions that lasted approximately 20 minutes each.

Picture judgment task

Stimuli

The art stimuli are listed in Appendix A. Twelve pieces of museum art, six from each of the emotions happy and sad, were presented to children. The art encompassed a range of artistic styles, periods and artists, and did not contain any human figures that could directly cue emotion through facial or postural expression. Postcards of the artwork were machine copied in colour, enlarged to a common size (8 × 10 in.), enclosed in a plastic cover, placed in a binder and presented individually by turning the pages. The colour photographs of the artists unambiguously expressing the emotions happy and sad were mounted in plastic standing frames. No features of the photographs could directly cue whether the painting matched the affect expressed by a particular artist.

Procedure

Children were told they were going to play a game in which they would find paintings made by different artists. They were presented with the photographs of the artists and told that these artists had made a number of paintings, and that the artists were feeling different emotions when they made the paintings. The experimenter first labelled the emotion felt by the artist as she showed the photograph to the child, and then asked the child to label how the artist felt before presenting the paintings, saying 'So how does this artist feel? And this one?'. All children correctly labelled the emotion expressed by the artist. The experimenter then instructed the child in the following way, 'We're going to play a game where you find the paintings made by these artists. Some of the paintings were made by the Sad artist when she was feeling sad, and some were made by the Happy artist when she was feeling happy. What you have to do is decide, each time I show you a painting, who did it. Did the Happy painter do it, or the Sad painter? The paintings are all mixed up so look carefully each time so you can decide who made the painting.' Paintings were presented individually immediately following instructions, and photographs of the artists were kept in view, one on either side of the binder.

Scoring

Responses were given 1 point if they matched the emotion (i.e. happy or sad) portrayed in the art piece, as determined by the pilot study with adult artists, and 0 if they did not match. The total number of matches of 12 was then calculated for each child and used in subsequent data analyses.

Interview task

Procedure

Only 5- and 7-year-olds were probed more deeply about their views on the relation between the emotion felt by an artist and the emotion portrayed by that artist in a painting. Three-year-olds were not interviewed because they were not expected to perform above chance in the picture judgment task. The interview questions were thus expected to identify whether children who had successfully matched paintings with the photograph of an artist expressing an emotion were firm in their belief that there was a one-to-one correspondence between artists' mood and emotion portrayed in the painting (i.e. happy artist paints happy pictures, sad artist paints sad pictures), or alternatively, believed the artists' mood may not necessarily directly predict the mood portrayed (i.e. a happy artist could also paint a sad painting, and vice versa). In addition to a number of filler questions, we asked three target questions in the interview.

(1) Whether a painter would make a painting that matched the painter's mood (Artist's Mood).
(2) Whether it was possible for a painter to make a painting opposite to the mood they were feeling when they made the painting (Opposite Mood).
(3) After identifying events that had made the child themselves happy and sad, children were asked whether a painter could make a painting that was opposite in mood to the personal events identified by the child (Relevant Subject).

This last question was chosen to make it more likely that children could relate to the questions because it had personal relevance, however, it may make it less likely that children would feel it was possible for an artist to make a drawing opposite to the mood evoked by that personal event. The interview task was always conducted at the end of the session.

Scoring

The proportion of children answering yes to the three questions identified above was calculated for each age group and compared with the proportions expected using the binomial (p=.50). The first question (Artist's Mood) was expected to be answered in the affirmative at both ages, and the second and third questions were expected to be more likely to be answered in the affirmative in older as compared to younger children.

Crayon false belief task

Stimuli

A box for 16 Crayola crayons was filled with Band-Aids and used as the prop for this task. In addition, a 10-in. high child doll named 'Pat', which was gender neutral in name, dress and appearance, was used to help children consider the other person's view.

Procedure

In this task, based on Study 2 from Perner *et al.* (1987), children were first introduced to the doll and told they were going to play a game with the doll. The experimenter used the following script to introduce and play the game, 'First we have to hide Pat in this box so he (or she if the child was female) can't see or hear anything we're doing.

He can't see anything can he? (All children agreed) Now, look at this (the experimenter pulls out the crayon box), what do you think is in here? What's in this box? (The experimenter waited for the child's response, and then repeated the child's answer, which in all cases was crayons.) Crayons! Let's look and see. You open the box and see what's inside. (The experimenter peered toward the box, waiting for the child's response.) What's in the box? Band-Aids! What a silly thing, Band-Aids in the crayon box! Now we're going to get Pat out and see what Pat thinks. (The experimenter asked the child to close the crayon box, and then pulled the doll from its hiding place in the box.) What does Pat think is in the box? (The experimenter waited for the child's response.) Now show Pat what is in there.'

Scoring

Children were given 1 point if they answered 'crayons' to both questions and 0 otherwise.

Emotion false belief task

Stimuli

The stimuli used in this task are presented in Appendix B. All were stories from earlier research (Gross & Harris, 1988; Harris, Donnelly, Guz, & Pitt-Watson, 1986) or new stories based on the rationale of those researchers. In half of the stories a positive emotion, and in the remaining half a negative emotion, was highlighted. Stories also varied according to whether the story protagonist would show or hide emotions. In Discrepant stories a reason was given for the story protagonist to hide their emotions from other story characters, and in NonDiscrepant stories a reason was given for the protagonist to show how they really felt. This distinction allowed us to determine whether children were aware that there is not always a one-to-one correspondence between felt emotion and emotion portrayed through facial expression. Each child listened to eight stories (four Discrepant, two each positive and negative, and four NonDiscrepant, 2 each positive and negative). Each story had a main character named David (for boys) or Diana (for girls). Children were introduced to the task with the following instructions. 'We're going to listen to some stories about a girl named Diana. I'm going to ask you about how Diana really feels inside in these stories, and how she looks on her face. She might really feel sad (happy) inside but look happy (sad) on her face. Or she might really feel sad (happy) inside and look sad (happy) on her face. So she might look a different way on her face, or the same way. Each time I'll tell you a new story about Diana and you have to listen carefully to see how she's feeling and how she will look on her face in that story.' Following these instructions the child was read the first story and then asked a series of questions from the categories of memory, reality, appearance and other's view (Gross & Harris, 1988). Examples of these questions for the first story are given in Appendix B.

Memory questions were asked first, and if children were unable to answer these questions correctly the story was reread and the questions reposed. If the child could not answer the memory questions correctly on three consecutive tries, the experimenter moved to the next story. The order of reality and appearance questions were counterbalanced across children and the other's view question was always asked last, as it required inserting the child's response to reality and appearance questions into the question. The first memory question focused on the situation causing the

protagonist's real emotion, and the second concerned the reason for displaying either the same or a different emotion. The reality question asked how the protagonist would really feel. The appearance question asked how the protagonist would look on her face. The other's view question asked what the other story characters would think about how the protagonist was feeling. The order of stories was randomized for each child.

Scoring

In all stories, points were given only when the child's choice of the emotion in the reality question was appropriate (i.e. matched the one highlighted in the story). For Discrepant stories 1 point was given for each time different emotions were chosen for reality and appearance questions, and the response for the other's view question matched the appearance question. For NonDiscrepant stories, 1 point was given whenever appropriate and identical emotions were chosen for the reality, appearance, and other's view questions. Each child's total score (of 8) across Discrepant and NonDiscrepant stories was then subjected to analyses.

Interpretive theory of mind task

Stimuli

Black-and-white line drawings were machine copied onto white cover stock and blank white covers with small rectangular windows, similar to those used by Pillow and Henrichon (1996), were used as stimuli. The covers and drawings were connected on the edge so that they did not shift during presentation. A small portion of the drawing was visible through the window on the cover; this portion was identical within each set of three drawings. There were eight sets consisting of three drawings in each set. For six sets (Change), the first and second drawings in the set were identical and the third was different. For two sets (NoChange), all three drawings in the set were identical. NoChange sets were included as a control to ensure that children did not expect there to be a change on all trials, but data from these sets were not analysed. An example of the Change sets, and the portion of the drawing revealed by the window, is given in Fig. 3, and details of the drawings and portions visible for each trial are given in Appendix C.

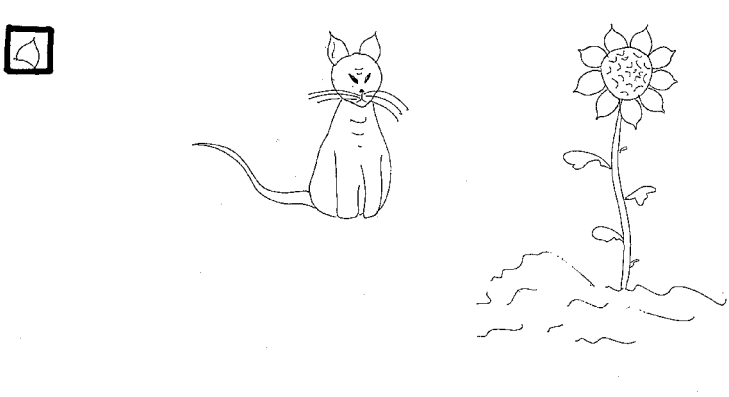

Figure 3. Sample drawings used in the interpretive task of Study 3.

Procedure

Each child was introduced to the task in the following way. 'We're going to play a game with our friend Pat (same doll as the one used in the crayon task). First we're going to hide Pat in the box so he (she) can't see or hear anything we're doing because first it's your turn to play the game. (Doll was put in the box.) Can Pat see anything from here? (All children agreed that Pat could not.) Now I'm going to show you some pictures and I want you to tell me what you think is behind the little window. Look at this one. What kind of picture do you think is behind this window? (The experimenter waited for the child to reply and then opened the picture cover to reveal the drawing behind the window.) Look it's a (e.g. cat)! There was a (e.g. cat) behind the window. Now how about this one (the second picture in the series was placed before the child), what do you think is behind this one? (The experimenter waited for the child to reply, opened the picture cover to reveal the drawing behind the window, and named the depicted object.) And what about this one (the third picture in the series was placed before the child), what do you think is behind this window? (The experimenter waited for the child to reply, opened the picture cover to reveal the drawing behind the window, and then named the depicted object.) OK, you saw a (e.g. cat, cat, flower), that's neat. Now let's get Pat out because we're going to do the same game with Pat. (The experimenter placed the same three covered drawings the child had just looked at on the table.) How about this first one, what will Pat think is behind the window?' As with the child, the experimenter presented each picture, asked the child what the doll would think was behind the window, opened the cover and named the object. The same script was used for all eight sets of three drawings. The order of sets was randomized for each child with the restriction that the third and sixth sets were always NoChange sets.

Scoring

Children were awarded 1 point for each set of Change drawings for which they attributed a biased interpretation to the puppet (i.e. said that the puppet would think the third drawing was a house in the house/house/shark sequence) and answered the reality question (i.e. what was really behind the window for the third drawing) for that set correctly (i.e. shark for the house/house/shark sequence). The total score (of 6) for each child was then analysed.

Results and discussion

Picture judgment task

Children's number of correct responses was defined as a match between the emotion portrayed by the painting (as defined by artist's judgments in the pilot study) and the mood portrayed by the artist in the photo. These data were analysed in a 3 Ages one-way ANOVA. A significant main effect of Age, $F(2, 34)= 28.08$, $p<.0001$, was obtained. Seven-year-olds performed significantly better ($M = 11.00$, $SD = 0.95$) than 5-year-olds ($M = 9.15$, $SD = 1.53$), who in turn performed better than 3-year-olds ($M = 6.33$, $SD = 2.06$). As predicted, 3-year-olds performed at chance level ($t = 0.56$) in the picture judgment task, whereas 5-and 7-year-olds were both above chance levels ($t = 8.42$, $p<.001$ for 5-year-olds and $t = 18.17$, $p<.001$ for 7-year-olds). Thus, in contrast to the youngest children, 5- and 7-year-olds apparently match mood of artist to mood portrayed in the painting according to a one-to-one mapping rule. Whether this

mapping rule is flexible, and the child concedes that other non-direct relationships may hold between artists' mood and product, was addressed in the analysis of interview data (see below).

Crayon false belief task

None of the 3-year-olds, 10/12 5-year-olds and 12/12 7-year-olds passed the crayon false belief task. The probabilities of these outcomes, based on the binomial distribution ($p = .50$ for a pass/fail task), are .0002 (significant failure) for 3-year-olds, .02 (significant success) and .0002 (significant success) for 5- and 7-year-olds respectively. These findings are consistent with others in the literature for studies using this type of false belief task (Perner *et al.*, 1987). There was no evidence that 3-year-olds considered the mental state of the other when making their judgments, unlike 5- and 7-year-olds, who were close to ceiling on the task.

Emotion false belief task

Number of correct responses was analyzed in a 3 Ages one-way ANOVA. There was a significant main effect of age, $F(2, 34) = 16.95$, $p<.001$. As expected, performance was poor and equivalent for 3- (0.25) and 5-year-olds (0.77) in this task, and significantly better for 7-year-olds (3.58). However, and contrary to our expectations, the group mean was at chance for 7-year-olds and only two children performed significantly above chance (4/8 in this task). It is not clear why children performed poorly. Inspection of the reasons given for responses suggest that children in this age group were more likely to give appropriate answers to the reality question (proportion of children giving appropriate answer = .73), than the appearance (.32) or other's view (.31) questions. Thus, it appears that our sample of 7-year-olds expressed a stage of transition, not yet fully understanding the idea that people may be motivated to hide emotions as a means of creating a false belief in others. Although the two children who performed above chance on the emotion task also responded affirmatively to all three questions in the interview, indicating a flexible view on the impact of the artist's mood on the painting, it is not possible with only two children to assess whether children's view of the mind behind the symbol is related to reasoning underlying the emotion theory of mind task.

Interpretive theory of mind task

A 3 Ages one-way ANOVA of children's number of correct responses on the interpretive theory of mind task revealed a significant effect of Age, $F(2, 34) = 9.21$, $p < .0006$. Three-year-olds (0.17) were equivalent to 5-year-olds (1.08), and both performed less well ($p < .05$) than 7-year-olds (2.62). As with the emotion task, none of the age groups was performing above chance level (3/6) in the interpretive task. However, 5/12 7-year-olds were performing at 67% or above. Again, this may indicate that the 7-year-old children in our sample are in a transition period, not yet fully understanding that the same experience can lead to different representations.

Comparison of picture judgment to theory of mind tasks

We explored trends across tasks using contingency tables and chi-square analyses. The following criteria for passing each task were employed: Picture Judgment, score of 9–12

(total possible = 12); Crayon False Belief, score of 1 (total possible = 1); Emotion False Belief, score of 6–8 (total possible = 8); Interpretive Theory of Mind, score of 5–6 (total possible = 6). All passing scores were 75% or above. Table 4 presents the number of children passing/failing the picture judgment and theory of mind tasks. Chi-square analysis of the contingency table contrasting picture with crayon tasks showed that a significant majority of children either passed both tasks or failed both tasks, χ^2 (1) = 16.55, p<.001, suggesting a link between the mental state reasoning required in these two tasks. Very few children passed one task and failed the other. In contrast, comparison of picture and emotion tasks revealed that children who failed the emotion task were equally likely to pass or fail the picture task, χ^2 (1) = 3.42, *ns*. Comparison of picture and interpretive tasks also indicated that a significant majority of children were equally likely to pass or fail picture tasks when they had failed the interpretive task, χ^2 (1) = 1.51, *ns*.

Table 4. Number of children who pass/fail picture judgment compared with theory of mind tasks in Study 3

	Theory of Mind Task					
	Crayon		Emotion		Interpretive	
	Pass	Fail	Pass	Fail	Pass	Fail
Picture task						
Pass	19	2	4	17	2	19
Fail	4	12	0	16	0	15
χ^2	16.55, p<.001		3.42, *ns*		1.51, *ns*	

These results suggest that judging how artists' mental states affect the product (picture judgment task) may require reasoning about mental states that is akin to that employed when children infer that different experiences lead to different representations of the world (Crayon false belief task). In both cases, a one-to-one mapping of mental state to behaviour/product appears to be made. It does not appear that the reasoning involved in judging the mind behind the symbol in the picture task relates to the more sophisticated reasoning of the emotion and interpretive tasks. In the latter two tasks the child must understand that there is not necessarily a one-to-one mapping between mental state and behaviour; that people may hide emotions to create a false belief in others (emotion task) or that two people looking at the same bit of information could form different interpretations (interpretive task). If this understanding was applied to the picture task, we would have children informing us that it was not possible to tell which artist did a particular painting; in effect reaching Goodman's (1968) point of realization that the emotion expressed resides in the symbol and not the artist. In fact, all children completed the task without challenging the instructions. To explore further the limits of children's view of the mind behind the symbol we looked at interview data.

Interview

We asked three target questions of 5- and 7-year-olds in these interviews. An affirmative answer in the second and third questions would reveal that children were developing a

more flexible view of how the mental state of artists could influence the paintings they make. Table 5 presents the proportion of children at each age answering in the affirmative to the questions. When asked what sort of painting a happy/sad artist would paint (Artist Mood), all 7-year-olds ($p < .0002$ from binomial distribution) and ten 5-year-olds ($p < .02$) responded that they would make paintings that matched their mood. Note that this reasoning leads to success on the picture task, and that if performance is converted to proportions similar levels are found in both tasks (.76 vs. .83 for picture vs. interview tasks for 5-year-olds and .92 vs. 1.00 for picture vs. interview tasks for 7-year-olds). The second and third questions pushed the limits of children's views.

Table 5. Proportion of children answering affirmatively to interview questions in Study 3

Question	5 Years	7 Years
1. Artist's Mood	.79	1.00
2. Opposite Mood	.63	.67
3. Relevant Subject	.21	.29
3a. With Skill	.46	.79

When asked in the second question whether those artists *could* make a painting that was opposite to their mood, six 5-year-olds ($p < .23$) and eight 7-year-olds ($p < .12$) conceded that they could. However, when asked in the third question to name a happy/sad event they had experienced and then asked whether an artist could make a painting that was opposite to the feeling evoked by that event (Personally Relevant Subject), only one 5-year-old ($p < .002$) and five 7-year-olds ($p < .19$) believed they could. However, when pushed a little further and asked whether the artist could do that if they were very skilled, six of the 5-year-olds ($p < .23$) and seven of the 7-year-olds ($p < .19$) conceded that they could. Apparently, most children felt that going against one's mental state in creating a painting would be a difficult thing to accomplish, and they felt it was even more implausible if the artist was painting a subject that was personally relevant to the child. Older children were more likely to believe that under certain circumstances (high levels of skill) it was possible.

Of the four children who passed the emotion task (all were 7-year-olds), all also agreed in the interview that painters could make paintings opposite in mood to the one they felt. Only two children (both 7-year-olds) passed both the emotion and interpretive tasks. In both cases the children exhibited a flexible view of the mind behind the symbol in their answers to interview questions (i.e. answered affirmatively to second and third questions). Although these relationships supports our prediction that children who have a more sophisticated theory of mind would also have a flexible view of the relationship between mental state of artist and the product they make, it can only be suggestive until more individuals having an advanced theory of mind are studied.

GENERAL DISCUSSION

Three studies explored the emergence of an ability in young children to reason about how artists may leave a trace of their attributes in the visual symbols they produce. In Studies 1 and 2 we presented children with simple line drawings and asked them to make judgments about the idiosyncrasies of the artist who produced them. In Study 3

we presented children with copies of museum art, again asking them to judge paintings on the basis of the attributes of the artist. We found that in general, beyond 4 years, children were increasingly able to differentiate between pictures on the basis of a variety of human qualities, including sentience, age level, affective style and emotion.

In Study 1, children's informal remarks about the drawings suggested that they based their judgments of the link between artists' attributes and pictures on a sensitivity and processing of specific features of the drawings such as the quality of the line, whether it formed a smooth continuous curve or was choppy or unsteady, and whether the line successfully enclosed the form without gaps or overlaps. Results of the first study clearly indicated that from 5 years children begin to have a clear sense of the relation between the experience and skill of the artist and their graphic production. More research is needed to decide whether this development is linked not only to a new sense of others (e.g. emerging theories of mind), but also to the development of aesthetic judgments, in particular judgments of relative beauty, an important topic we did not address here.

In Study 2, we varied affective style, isolating a number of factors that naïve adults associated with drawings produced by calm or agitated artists, and found that children were also sensitive to these factors. In general, precision was valued and used as a criterion of differentiation by children. This finding corroborates research showing that young children prefer realist over more abstract artistic productions (e.g. Freeman, 1993b; Parsons, 1987). However, considering the variety of artistic styles across cultures, questions remain as to whether precision is a universal value in the development of art appreciation and understanding. These questions should be addressed with further cross-cultural studies.

Study 3 was a first attempt to explore the relationship between mental state reasoning with visual symbols and theory of mind tasks. Consistent with the existing literature, we found that prior to 4 years, children did not show evidence of mental state reasoning in any of the four tasks (picture, crayon, emotion, interpretive). In contrast, 5- and 7-year-olds pass picture and crayon tasks, but not emotion and interpretive tasks. We proposed that the one-to-one framework of mental state reasoning is a common thread between picture and crayon tasks, and that this framework indexes a first step of mental state understanding. Thus, we suggest that at the onset of mental state understanding children presented with the crayon false belief task believe that the experiences of the protagonist in the story will be directly reflected in their beliefs in a one-to-one manner (i.e. crayons are usually found in crayon boxes and so in this particular crayon box there are crayons). Likewise, at this early state of understanding children believe that the artists' moods will be directly reflected in the mood portrayed in the drawings they make (i.e. happy artists make happy drawings). We did not find that 7-year-olds performed well on the more advanced theory of mind tasks (i.e. emotion and interpretive). Very few children in our sample manifested the more sophisticated view of mind that was tapped by the emotion and interpretive tasks. The few who did, however, also showed a more sophisticated understanding of the mind behind the symbol – they conceded that although the artist's mood would likely be reflected in the symbol, it would not necessarily be so. Extending the age range studied would help to confirm the interpretation of the developmental trend that is suggested by the present findings.

Our findings support the contention made by Freeman (1993a,b, Freeman & Sanger, 1993) and Browne and Wolley (2001) suggesting that children reason about the role of the artist relatively late compared with using pictures as symbols in a variety of tasks

(e.g. Callaghan, 1999, 2000a; DeLoache, 1991; DeLoache *et al.*, 1997). We propose that this lag is probably due to differential demands of the tasks. In tasks asking children to use pictures as symbols, the child needs to match relevant information from the symbol to the referent. When the match is direct, as in Callaghan (2000a), in which 3-year-old children match realistic drawings to the objects depicted symbol use emerges earlier than when the match is indirect, as in Callaghan (2000b), in which 5-year-old children infer emotions portrayed in paintings.

Our claim is that in the picture judgment task used here, contrary to previous visual symbol tasks, the child also needed to make an inference. Specifically, an inference of how the mental state of the artist could translate into pictorial qualities. However, it could be argued that children could make a low-level judgment of the pictures presented in this series, for example, by simply distinguishing the positive/negative valence. For example, the child may gloss the adult, machine, calm and happy pictures as good or positive and the child, agitated and sad pictures as bad or negative. To eliminate this explanation, we asked fifteen 3-year-olds to judge a sample of 24 pictures drawn from the stimulus sets of Studies 1 and 2. The pictures were presented in pairs that contrasted either the child with adult drawing of an object, or the calm with agitated baseline drawing of an object. In one pass through the set, children were asked to find the 'good' drawing and in the second pass they were asked to find the 'bad' drawing, with order counterbalanced across children. Mean proportion correct was .89 for 'good' judgments and .78 for 'bad' judgments. This finding suggests that if they were making a low-level judgment of valence in our studies, 3-year-old children in our studies would have performed much better that they did (.52 in Study 1, .50 in Study 2 and .53 in Study 3). Taken together, the findings from this follow-up study, the consistently poor performance of young children across these three studies and the links found to early mental state reasoning in theory of mind and interview data in Study 3 converge on an interpretation that we have tapped children's developing ability to keep attributes of the artist in mind when making judgments of pictures.

The inference of the mental state of the artist required by our task may also explain why our results do not fit with the view that even 3-year-olds consider intentions of the artist when naming pictures (Bloom & Markson, 1998; Gelman & Ebeling, 1998). In the naming studies, the intentions of the artist are explicitly told to children before they make their judgments, and as long as intentions do not conflict with resemblance (Browne & Wolley, 2001), they use this information when naming drawings. In order to determine the limits of children's pictorial reasoning, future research will need to carefully identify the sources of support provided to children when they make judgments of how the artist influences the trace. Our findings with the three picture tasks employed here suggest that when children begin to show solid causal mental state reasoning (around 4–5 years), they also begin to make judgments of how the mind of the artist is reflected in their productions. We believe that, just as with theory of mind, there is room for considerable refinement of children's view on the mind behind the symbol. Future research needs to extend the age range and the cultural group studied to explore the nature of this refinement.

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References

Arnheim, R. (1974). *Art and visual perception: A psychology for the creative eye*. Los Angeles: University of California Press.

Bloom, P., & Markson, L. (1998). Intention and analogy in children's naming of pictorial representations. *Psychological Science, 9*, 200–204.

Browne, C. A., & Wooley, J. D. (2001). Theory of mind in children's naming of drawings. *Journal of Cognition and Development, 2*, 389–412.

Callaghan, T. C. (1997). Children's judgments of emotion portrayed in museum art. *British Journal of Developmental Psychology, 15*, 515–529.

Callaghan, T. C. (1999). Early understanding and production of graphic symbols. *Child Development, 70*, 1314–1324.

Callaghan, T. C. (2000a). Factors affecting graphic symbol understanding in the third year: Language, similarity and iconicity. *Cognitive Development, 15(2)*, 207–236.

Callaghan, T. C. (2000b). Preschoolers' judgments of emotion in museum art. *British Journal of Developmental Psychology, 18*, 465–474.

Carouthers, T., & Gardner, H. (1979). When children's drawings become art: The emergence of aesthetic production and perception. *Developmental Psychology, 15*, 570–580.

Chandler, M., & LaLonde, C. (1996). Shifting to an interpretive theory of mind: 5- to 7-year-olds' changing conceptions of mental life. In A. Sameroff & M. Haith (Eds.), *The five to seven year shift: The age of reason and responsibility*. Chicago: University of Chicago Press.

DeLoache, J. S. (1991). Symbolic functioning in very young children: Understanding pictures and models. *Child Development, 62*, 736–752.

DeLoache, J. S., & Burns, N. M. (1994). Early understanding of the representational function of pictures. *Cognition, 52*, 83–110.

DeLoache, J. S., Pierroutsakos, S. L., & Troseth, G. L. (1997). The three r's of pictorial competence. In R. Vasta (Ed), *Annals of child development* (*Vol. 12*, pp. 1–48). London: Jessica Kingsley.

Freeman, N. H. (1993a). Drawing: Public instruments of representation. In C. Pratt & A. F. Garton (Eds.), *Systems of representation in children: Development and use*. New York: Wiley.

Freeman, N. H. (1993b). *Theory of mind, theory of pictures: A conceptual advance in childhood*. Paper presented at the VIIIth Congresso Nazionale, Divisione Psicologia dello Sviluppo, Roma.

Freeman, N. H. (1995). The emergence of a theory of pictorial reasoning. In C. Lange-Kuttner & G. V. Thomas (Eds.), *Drawing and looking: Theoretical approaches to pictorial representation in children*. London: Harvester Wheatsheaf.

Freeman, N. H., & Sanger, D. (1993). Language and belief in critical thinking: Emerging explanations of pictures. *Exceptionality Education Canada, 3(3)*, 43–58.

Gardner, H. (1973). *The arts and human development*. New York: Basic Books.

Gelman, S. A., & Ebeling, K. S. (1998). Shape and representational status in children's early naming. *Cognition, 66*, 35–47.

Goodman, N. (1968). *Languages of art: An approach to a theory of symbols*. New York: Bobbs-Merrill.

Gross, D., & Harris, P. L. (1988). False beliefs about emotion: Children's understanding of misleading emotional displays. *International Journal of Behavioral Development, 11(4)*, 475–488.

Harris, P. L. (1983). Children's understanding of the link between situation and emotion. *Journal of Experimental Child Psychology, 36*, 490–509.

Harris, P. L. (1989). *Children and emotion: The development of psychological understanding*. Oxford: Blackwell.

Harris, P. L., Donnelly, K., Guz, G. R., & Pitt-Watson, R. (1986). Children's understanding of the distinction between real and apparent emotion. *Child Development, 57*, 895–909.

Harris, P. L., Johnson, C. N., Hutton, D., Andrews, D., & Cook, T. (1989). Young children's theory of mind and emotion. *Cognition and Emotion, 3*, 379–400.

Harris, P. L., Kavanaugh, R. D., & Dowson, L. (1997). The depiction of imaginary transformations: Early comprehension of a symbolic function. *Cognitive Development, 12*, 1–19.

Jolley, R. P., & Thomas, G. V. (1994). The development of sensitivity to metaphorical expression of moods in abstract art. *Educational Psychology, 14*, 437–450.

Karmiloff-Smith, A. (1992). *Beyond modularity: A developmental perspective on cognitive science*. Cambridge, MA: MIT Press.

Kirk, R. (1968). *Experimental design: Procedures for the behavioral sciences*. Belmont, CA: Brooks/Cole Publishing.

Langer, S. K. (1953). *Feeling and form*. New York: Scribner's

Nye, R., Thomas, G. V., & Robinson, E. (1995). Children's understanding about pictures. In C. Lange-Kuttner & G. V. Thomas (Eds.), *Drawing and looking: Theoretical approaches to pictorial representation in children*. London: Harvester Wheatsheaf.

Parsons, M. (1987). *How we understand art: A cognitive developmental account of aesthetic experience*. Cambridge: Cambridge University Press.

Perner, J. (1991). *Understanding the representational mind*. Cambridge, MA: MIT Press.

Perner, J., Leekham, S. R., & Wimmer, H. (1987). Three-year-olds' difficulty with false belief: The case for a conceptual deficit. *British Journal of Developmental Psychology, 5*, 125–137.

Pillow, B. H., & Henrichon, A. J. (1996). There's more to the picture than meets the eye: Young children's difficulty understanding biased interpretation. *Child Development, 67*, 803–819.

Robinson, E., Thomas, G. V., & Nye, R. (1994). Children's conceptions of the relationship between pictures and their referents. *Cognitive Development, 9*, 165–191.

Russell, J. A., & Bullock, M. (1985). Multidimensional scaling of emotional facial expressions: Similarities from preschoolers to adults. *Journal of Personality and Social Psychology, 48*, 1290–1298.

Thomas, G. V., Nye, L., & Robinson, E. (1994). How children view pictures: Children's responses to pictures as things in themselves and as representations of something else. *Cognitive Development, 9*, 141–144.

Wimmer, H., & Perner, J. (1983). Beliefs about beliefs: Representation and constraining function of wrong beliefs in young children's understanding of deception. *Cognition, 13*, 103–128.

Winner, E. (1982). *Invented worlds: The psychology of the arts*. Cambridge, MA: Harvard University Press.

Winner, E., Blank, P., Massey, C., & Gardner, H. (1983). Children's sensitivity to aesthetic properties of line drawings. In D. Rogers & J. A. Sloboda (Eds.), *The acquisition of symbolic skills* (pp. 97–104). New York: Plenum.

Winner, E., Rosenblatt, E., Windmueller, G., Davidson, L., & Gardner, H. (1986). Children's perception of 'aesthetic' properties of the arts: Domain-specific or pan-artistic? *British Journal of Developmental Psychology, 4*, 149–160.

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Appendix A

Painting reproductions used as stimuli in Study 3

Happy emotion paintings

(1) *Gouache*, by Alexander Calder, 1973.
(2) *The Red Boats, Argenteuil*, by Claude Monet, 1875.
(3) *Autumn Landscape, Murnau*, by Vasily Kandinsky, 1908.
(4) *Spring in France*, by Robert William Vonnoh, 1890.
(5) *The Pigeons*, by Pablo Picasso, 1957.
(6) *Untitled*, by Alexander Calder, 1964.

Sad emotion paintings

(7) *Painting Number 2*, by Franz Kline, 1954.
(8) *Rain*, by Vincent VanGogh, 1889.
(9) *Black Cross, New Mexico*, by Georgia O'Keefe, 1929.
(10) *Burning of the Houses of Parliament*, by Joseph Mallord William Turner, c. 1835.
(11) *Snowfield Morning, Roxbury*, by John LaFarge, 1864.
(12) *Royal Dirge*, by Robert Motherwell, 1972.

Appendix B

Stories and sample questions used in emotion false belief task of Study 3

Discrepant

(1) Diana is playing a game with her friend. At the end of the game Diana wins and her friend loses. Diana tries to hide how she feels because otherwise her friend won't play with her anymore.
Memory Q1. What happened at the end of the game?
Memory Q2. What will Diana's friend do if she knows how Diana feels?
Reality Q. How does Diana really feel when she wins the game? Does she really feel happy, sad or just OK? Why?
Appearance Q. So Diana really feels (child's response) when she wins the game. How does she look on her face when she wins the game? Does she look the same way or a different way? Does she look happy, sad, or just ok on her face? Why?
Other's view Q. So Diana really feels (child's response) and she looks (child's response) on her face. What about her friend? Does her friend think Diana is happy, sad or just OK? Why?
(2) Diana and her friends are playing together. One of the oldest children squirts Diana with a squirt gun right in the face. Everyone else laughs, but Diana doesn't think it is funny. Diana knows that the other children will say she's a baby if she shows them how she really feels. So Diana tries to hide how she really feels.
(3) Diana sees a big boy picking on a little boy. Suddenly, the big boy runs past Diana really fast. Then the big boy trips and falls. Diana thinks that it's funny. But she doesn't want the boy to know how she feels in case he picks on her too.
(4) Diana is walking down the street when an old lady walks past her. The old lady is

wearing funny clothes. Diana tries to hide the way she feels when she sees the old lady's funny clothes otherwise the old lady might be cross with her.

NonDiscrepant

(5) Diana is getting ready for school but she has a sore tummy. Diana knows that if she shows her mommy how she really feels her mommy will let her stay home from school. So Diana lets her mom know how she feels.

(6) Diana's daddy is coming home from a long trip. Her mom is going to get him at the airport and Diana really wants to go. Diana knows that if she shows her mother how she really feels she will let her come to the airport too. So Diana lets her mom know how she feels.

(7) Diana is shopping with her mom for a birthday present for her friend. They find a really cool toy for her friend that Diana likes a lot. Diana knows that is she shows her mom how she feels her mom will buy her a toy too. So Diana lets her mom know how she feels.

(8) Diana is eating dinner with her granny, but Diana doesn't like the food her granny made. Diana knows that if she shows her granny how she really feels about the food, her granny will give her something else to eat. So Diana lets her granny know how she really feels.

Appendix C

Details of drawings used in the interpretive task of Study 3

	Full View			Restricted view
	Drawing 1	Drawing 2	Drawing 3	
Change sets				
(1)	House	House	Shark	Triangle (roof, fin)
(2)	Elephant	Elephant	Firefighter	Open Rectangle (end of trunk/hose)
(3)	Truck	Truck	Balloons	Quarter Circle (wheel, balloon)
(4)	Mouse	Mouse	Rhinoceros	Curved spike (tip of tail/horn)
(5)	Tiger	Tiger	Butterfly	ZigZag Stripes(fur, wing pattern)
(6)	Cat	Cat	Flower	Pointed Oval (ear, petal)
NoChange sets				
(7)	Tree	Tree	Tree	Straight parallel lines (trunk)
(8)	Snake	Snake	Snake	Curved parallel lines (body segment)