Young Children's Psychological Explanations and their Relationship to Perception- and Intention-Understanding

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The present study examined two key aspects of young children's ability to explain human behaviour in a mentalistic way. First, we explored desires that are of a level of difficulty comparable with that of false beliefs. For this purpose, the so-called 'alternative desires' were created. Second, we examined how children's psychological explanations are related to their understanding of perception and intention. A perception-understanding task, an intention-understanding task and a psychological-explanation task were administered to 80 three-year-olds. Results offer support for the thesis that the level of difficulty of belief and desire explanations is comparable. Moreover, children's psychological explanations are related to their understanding of perception and intention. The results lend support to the idea that mentalistic explanations are an explicit manifestation of children's level of theory of mind.   Copyright © 2008 John Wiley & Sons, Ltd.

Key words: theory of mind; perception; intention; psychological explanations; alternative desires

INTRODUCTION

Just before their third birthday, children start to talk about what they or other people do in terms of desires, intentions, perceptions and beliefs (Bartsch & Wellman, 1989, 1995; Dunn, 1991; Schult & Wellman, 1997; Wellman, 1990; Wellman & Liu, 2004). Using an experimental procedure, Bartsch and Wellman

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showed that three-year-olds were just as good as four-year-olds and adults at explaining actions in terms of psychological explanations. This result has been confirmed by naturalistic investigations of children's use of mental-state terms in everyday speech (Bartsch & Wellman, 1995; Dunn, 1991). Moreover, at the age of three, children are able to explain in an appropriate way psychological, biological and physical stories using psychological, biological and physical explanations, respectively (Schult & Wellman, 1997). In other words, they are able to distinguish what should be explained mentalistically from what should not. Psychological explanations might be considered as an explicit means by which children show their understanding of the social world, which makes it relevant to study them. In the present study we examined two different aspects of children's use of psychological explanations when they are three years of age. The first aspect is the use of desire and belief explanations and whether they are of a comparable level of difficulty for young children. The second is whether and how children's first psychological explanations are related to their understanding of perceptions and intentions.

As far as the first aspect of the present study is concerned, children's psychological explanations refer mainly to desires and beliefs. Desire and belief are considered the most important mental states because they form the basis for understanding intentional actions (Bartsch & Wellman, 1989, 1995; Wellman, 1990). The understanding of these two mental states does not seem to develop concurrently. Children start to refer to desires even before their fourth year of life, but they start to refer to beliefs only in the course of that year (Bartsch & Wellman, 1989, 1995; Wellman & Liu, 2004). Moreover, many studies indicate that only after their fourth birthday are children able to understand and explain behaviour in terms of 'false belief' (Hogrefe, Wimmer, & Perner, 1986; Wellman, Cross, & Watson, 2001; Wimmer & Perner, 1983). Although recent research has also found evidence of an ability to understand false beliefs as early as the second year of life using a non-verbal task (Onishi & Baillargeon, 2005), it is only at around the end of the third year of life or the beginning of the fourth that children are able to predict and explain behaviour in terms of false beliefs using language.

Wellman and Liu (2004) reported on children's sequence of understanding in developing a theory of mind. They showed that children are able to understand what somebody wants (desire) before they are able to understand what somebody thinks (belief). Moreover, children are able to understand that somebody does not know something (ignorance) before they are able to understand that somebody has a belief that is not true (false belief). Nevertheless, desires are not always easier than beliefs. Moore et al. (1995) investigated children's ability to understand another person's desire when it conflicts with the child's own desire, called 'conflicting desire'. Children of three, four and five years performed well in understanding the desires of others when no conflicts were present. Yet three-year-olds as well as four-year-olds performed poorly when they had to understand conflicting desires as well as false beliefs. Rieffe et al. (2001) replicated the study, varying the intensity of the conflict. They found that five-year-olds are always able to predict the protagonist's desire, four-year-olds improve their performance when the difference between their own preference and the protagonist's preference is reduced, and three-year-olds perform poorly under all circumstances. Thus, three-year-olds find it difficult to predict others' actions prompted by their desires and preferences when there is a conflict between their own desire and the one that is attributed. This difficulty is very similar to young children's difficulty in judging another person's belief

when that belief is in conflict with what the child knows (i.e. false belief). More recently, Rakoczy, Warneken, and Tomasello (2007) examined whether there is symmetry or asymmetry in three-year-olds' understanding of incompatible desires and false belief. Their findings give support to the asymmetry hypothesis since young children were able to understand incompatible desire even though they mostly failed to understand false beliefs.

All these studies took into consideration the conflict between children's desires and the desires of a character in a story. Indeed they report on children's understanding of conflicting desires. However, desires may be as difficult to understand as false beliefs when they cannot be directly attributed on the basis of the situation. When we observe someone doing something that contrasts with the state of reality (for example, looking for a cat under the table when the cat is under the chair), we interpret the action as a false belief (the person looks under the table because he/she does not know the cat is under the chair). In the same way, when we observe someone doing something that contrasts with his/her preference (for example, taking an apple when he/she does not like apples), we interpret the action of the person by inferring an alternative desire (the person takes an apple because he/she wants to give it to someone else). In the present study we examined the contrast between the action and the preference of the protagonist (alternative desires) instead of the contrast between the preference of the child and the desires of the protagonist (conflicting desires). Moreover, we compared children's use of alternative-desire explanations with their false-belief explanations.

As far as the second aspect of the present study is concerned, we examined how three-year-olds' psychological explanations are related to their understanding of the social world, and in particular their perception- (visual perspective-taking) and intention-understanding. Children's understanding of perception has been considered an index of comprehension of the others' point of view (Flavell, 1999; Flavell, Everett, Croft, & Flavell, 1981; Masangkay *et al.*, 1974). Wellman, Phillips, and Rodriguez (2000) tested connected understanding of perception and emotion in three-year-olds. Children were able to predict the emotion of a third person on the basis of what this person was looking at and to report the perception of a third person based on the emotion being expressed by the person. Thus, already at the age of three, children are able to understand that people can experience different emotions or desires on the basis of their perception. However, children's understanding of perceptions precedes their understanding of false beliefs (Gopnik, Slaughter, & Meltzoff, 1994). It may be argued that the understanding of the others' point of view is a prerequisite to understand others' internal states such as desires and beliefs. For this reason we were interested in examining how children's understanding of perception may be related to the way they explain others' actions mentalistically.

Children are already able to show their understanding of intentions during the second year of life when using no linguistical procedures (Carpenter, Akhtar, & Tomasello, 1998; Meltzoff, 1995; Phillips, Wellman, & Spelke, 2002). However, the ability to report others' intentions emerges at the age of three years when children can say what they or other people want or intend to do (Moses, 1993; Shultz & Wells, 1985; Shultz, Wells, & Sarda, 1980). More recent studies have presented evidence that children's understanding of intentions is more difficult when it is examined separately from the understanding of desires. Feinfield, Lee, Flavell, Green, and Flavell (1999) presented children with stories in which they had to distinguish between the protagonist's desire, intention and belief. Four-year-olds were able to distinguish intentions and desires, but three-year-olds

were not. Also Schult (2002) investigated children's ability to recognize the causal nature of intentions, as distinguished from desires. Results showed that, at the age of three, the ability to distinguish between intentions and desires has not developed.

Russell, Hill, and Franco (2001) found that three-year-olds' difficulty in understanding intention is similar to their difficulty in understanding false belief. In their study, children were presented with a transparency on which there was an incomplete drawing (e.g. a boy's head missing an ear). The child was given a pen and invited to finish the drawing on the uppermost of two transparencies, one laid over the other, so that removing the top transparency showed that the lines drawn by the child had actually completed another drawing (e.g. a cup with the ear outline now representing the handle of the cup). Children were then asked whether they intended to draw an ear or a handle, or whether they were drawing an ear or a handle. Children of three years were not always able to state that they meant to draw the first and not the second drawing, and this performance was similar to performance in false-belief tasks. This study suggests that three-year-olds are still developing the ability to understand intentions; therefore, to interpret behaviour as intentional and psychologically driven. It might be argued that the understanding of intentions is related to a higher level of understanding of desires and beliefs. Together, perception- and intention-understanding may have an effect on the way children explain behaviour in a psychological way.

In the present study, we examined three-year-olds' explanations of human actions; in particular, psychological explanations and nested desire-belief explanations. Children's spontaneous explanations, as well as their explanations after a prompt (prompted explanations), were evaluated in order to examine how their performance improves. Our first aim was to explore a kind of desire that may be as difficult to understand as false belief. We called this kind of desire 'alternative desire'. We examined children's explanations of stories with an anomalous-belief content that may be explained using a false-belief explanation. In the same way, we examined children's explanations of stories with an anomalous desire content that may be explained using an alternative-desire explanation. Children's false-belief and alternative-desire explanations were compared. Our hypothesis was that children would find alternative-desire explanations as difficult as false-belief explanations.

Our second aim was to examine the relationship between children's psychological explanations and their understanding of perception and intention. We evaluated children on the basis of their understanding of perception and intention and examined their ability to use psychological, desire-belief, false-belief and alternative-desire explanations. Our hypothesis was that children who were able to understand perception and intention would be able to produce more psychological explanations than children who were not able to understand perception.

METHOD

Participants

Eighty three-year-olds ($M = 3.3$, S.D. $= 0.1$, range $= 3.0–3.8$; 45 girls and 35 boys) were recruited from child-care centres and paediatric departments in the city of Rome. The socio-economic levels of their families ranged from middle to middle-high (as determined by parental educational level).

Materials and Procedure

Children were observed at home or in a daycare center. The experimental observation was carried out in a quiet room in the house or center, and in the presence of a familiar figure (a parent or educator). Children received a warm-up period of about 10 min. After that, the children received three tasks. A perception-understanding task was administered first, as a pre-test, because it was easier than the other two tasks. Then, an intention-understanding task and a psychological-explanation task were administered in a counterbalanced way across the group of children. All the sessions were videotaped.

Perception-understanding task

A version of the Level 1 visual perspective-taking task developed by Flavell *et al.* (1981) was used. Children were shown a coloured, plastic card (12 cm × 12 cm) with a picture on one side (e.g. a dog) and a different picture on the other side (e.g. a cat). The experimenter showed the child that each side of the card displayed a different picture. Then she asked, 'What do you see, a dog or a cat? What do I see, a dog or a cat?' The child could answer either by naming the picture or by pointing to one side of the card. Three cards were used: Cat/Dog, Tree/Flower and Shoes/Sun. The order of presentation of the three cards and of the two questions was counterbalanced across the children. Children answered correctly if they reported both what they and the other person could see. Children were judged capable of perception understanding if they gave a correct answer for all three cards.

Intention-understanding task

The false-belief condition of the transparent intention task developed by Russell *et al.* (2001) was used. The child was shown a transparency on which there was an incomplete drawing (e.g. a boy's head without an ear). Then the child was given a pen and invited to finish the drawing. When the child finished, the experimenter revealed that the child had been drawing on the uppermost of two transparencies, one laid over the other. Removing the top transparency showed that the line drawn by the child had, in fact, completed the drawing of a cup on the top transparency, with the 'ear' outline now representing a handle of a cup. The experimenter then asked the child what he/she thought he/she had been drawing. 'Did you think you were drawing an ear or did you think you were drawing a handle?' Children were presented with four transparency pictures: (1) Ear (face)/Handle (cup); (2) Smoke (chimney)/Smoke (boat); (3) Top of the tree/Ice-cream; and (4) Face (girl)/Face (boy). The order of presentation of the four trials was counterbalanced as was the order of the two questions. Children were judged to have answered correctly if they reported that they thought they were drawing the previous drawing and not the 'actual' drawing. Children were attributed with intention understanding if they gave a correct answer for all four drawings.

Psychological-explanation task

A modified version of Bartsch and Wellman's procedure (1989; first study) was used. Children were presented with nine stories consisting of simple descriptions of a character engaging in a specific action. Each story was accompanied by an illustration of the story with the character, the object and the final location all presented on a single coloured page. There were three types of story: (1) neutral

Table 1. Stories used to describe action to be explained in the psychological-explanation task

Neutral stories	(1) Here is Marta. Marta is looking for her kitten behind the table
	(2) Here is Paolo. This is a piece of candy. Paolo is putting it in his mouth
	(3) Here is Maria. Maria is going to buy an ice-cream at the ice-cream store
Anomalous-desire stories	(1) Here is Giulia. These are apples. Giulia doesn't like apples. But now she is taking an apple
	(2) Here is Maria. This is a frog. Maria doesn't like frogs. But now she is looking for a frog behind the table
	(3) Here is Filippo. This is a snake. Filippo doesn't like snakes. But now he's trying to catch a snake
Anomalous-belief stories	(1) Here is Luisa. Luisa is looking for her kitten. The kitten is under the chair. But Luisa is looking behind the table
	(2) Here is Tommaso. This is a stone that looks like a peanut. Tommaso is putting it in his mouth
	(3) Here is Paolo. Paolo is going to this store. This store does not sell balloons. But Paolo is going to this store to buy a balloon

stories, in which the characters are engaging in simple actions (e.g. Here is Marta. Marta is looking for her kitten behind the table); (2) anomalous-desire stories, in which the characters are engaging in actions that do not directly fit with what the characters like (e.g. Here is Giulia. These are apples. Giulia doesn't like apples. But now she is taking an apple); (3) anomalous-belief stories, in which the characters are engaging in actions that are based on false beliefs (e.g. Here is Tommaso. This is a stone that looks like a peanut. Tommaso is putting it in his mouth). The three kinds of story were presented in counter-balanced order. Table 1 displays the nine stories used for the psychological explanation task.

For each story, after the experimenter had told the child what was happening, she asked explanation questions ('Why do you think ... is doing that?'). If the child responded with anything other than an attribution of desire or belief, the experimenter simply repeated the 'why' question with premise information. The aim of the second 'why' question was to extend the opportunities for the child to explain the action in terms of desires or beliefs. If the child did not respond with an attribution of desire or belief or the answer was not completely clear, following Bartsch and Wellman (1989), the experimenter posed a desire or a belief prompt ('What does ... want/think?'). Desire prompts were given on the anomalous-desire stories and on the second neutral story. Belief prompts were given on the anomalous-belief stories and on the first and third neutral stories.

Some control measures were used both for anomalous desire and belief stories. In anomalous-desire stories a question about the character's preference was asked (e.g. 'Does ... like it?'). In anomalous-belief stories a question about the real state of affairs was asked (e.g. 'Where is the kitten?').

Coding of Responses for the Psychological-Explanation Task

An adapted version of the coding system of Bartsch and Wellman (1989) was used. Each child's explanation for a single story was coded twice: First to characterize a spontaneous explanation on the basis of what was said in response

to the first and the second 'why' questions; Second to characterize a prompt explanation that was the child's comprehensive explanation, taking into account what was said before and after the belief or desire prompt. Spontaneous explanations represent children's spontaneous use of psychological terms in order to explain actions. Conversely, prompt explanations represent the complete result of the explanation process after the child has received a prompt. Children's explanations for the three types of story were coded as being one of three general types.

Psychological explanations and desire-belief explanations

Psychological explanations essentially included statements that invoked psychological causes, such as desires, beliefs and other psychological states such as physiology, perception, emotion, pretense, preference and traits. Nested in the category of psychological explanations, children's explanations that referred to desires and belief (and not the other psychological states) were also coded. Examples of psychological explanations were:

- Because she thinks it is there (belief).
- Because she wants to eat it (desire).
- Because he is hungry, he eats the stone but afterwards he has pain in his belly (other psychological explanations: physiology).

False-belief explanations

These were coded in the anomalous-belief stories. The false-belief explanations refer to a proper attribution of belief to the character which also takes account of the real state of affairs in explaining his/her action. Thus, the child is asked to explain the action with reference to a belief that is different from reality. Examples of false-belief explanations are:

- Because she didn't know the kitten was behind the chair.
- He thought it was a nut ... but it wasn't, it was a stone.
- He thought that the balloon was here instead of in another shop.

Alternative-desire explanations

In the anomalous-desire stories, a new kind of desire was coded, the alternative-desire explanation. This refers to a proper attribution of desire to the character which also takes into account his/her known preferences in explaining his/her action. Thus, the child is asked to explain the action with reference to a desire that is different from his/her preference. For this reason we called them 'alternative'. Examples of alternative-desire explanations are:

- She wants to take it to give it to her mother, she likes frogs.
- Because she wants to try again to see if she likes it.
- Because she wants to take it and throw it away!

Non-psychological explanations

This included explanations referring to non-psychological causes, such as external states of affairs, physical causes or explanations that may have been but were not clearly psychological. Examples of non-psychological explanations are:

- Because she has lost it.
- Because he bought a snake.
- Braaaaaahhhh [Yuk]!!! He takes it and he eats it.

No explanation attempted

This included failure to generate any explanation at all and statements of ignorance. When the child did not correctly answer a control question, his/her explanation was coded as 'No explanation attempted'.

Children received scores ranging from 0 to 9 in spontaneous and in prompted psychological explanations, reflecting the number of explanations given for all nine stories. The same scoring system was used to evaluate the nested category desire-belief explanations (spontaneous and complete). False-belief explanations and alternative-desire explanations received scores ranging from 0 to 3, reflecting the number of explanations given for anomalous-belief stories and for anomalous-desire stories, respectively.

Two independent coders categorized the explanations. Reliability was assessed for 25% of the sample. For neutral stories, Cohen's Kappa was 0.94 and 0.91 for spontaneous and prompt explanations, respectively. For anomalous-desire stories, Kappa was 0.95 and 0.94, and for anomalous-belief stories, Kappa was 0.93 and 0.92. Differences were resolved by discussion.

RESULTS

Children's Psychological Explanations

Preliminary analyses showed no effect of gender or order of story presentation on children's spontaneous and prompted explanations for the three types of story. These variables were therefore omitted from further analyses. Furthermore, children's production of spontaneous and prompted psychological and desire-belief explanations did not improve across stories. Table 2 presents means, standard deviations and confidence intervals for spontaneous and prompted psychological explanations as well as for desire-belief explanations produced by children.

In order to see whether children produced a different number of spontaneous and prompted explanations for the three types of story, four within-subjects analysis of variances (ANOVAs) were conducted, one for each kind of explanation. Children's production of spontaneous psychological explanations

Table 2. Means, standard deviations and confidence intervals for spontaneous and prompted psychological explanations and desire-belief explanations produced by children in the three types of story

		Neutral (0–3)			Anomalous desire (0–3)			Anomalous belief (0–3)			Total (0–9)		
		M	S.D.	+95%	M	S.D.	+95%	M	S.D.	+95%	M	S.D.	+95%
Spontaneous	Psychological	1.84	0.99	0.22	1.96	1.07	0.24	1.65	1.16	0.26	5.46	2.63	0.59
	Desire belief	0.95	0.98	0.22	1.41	1.15	0.26	1.06	1.11	0.25	3.42	2.61	0.58
Prompted	Psychological	2.41	0.87	0.20	2.51	0.79	0.18	2.42	1.00	0.22	7.35	2.18	0.49
	Desire belief	2.09	0.98	0.22	2.29	0.93	0.20	2.00	1.18	0.26	6.37	2.56	0.57

was significantly different for the three types of stories ($F(2, 158) = 3.28$, $p < 0.05$; $\eta^2 = 0.04$). A test of within-subjects contrasts revealed that the number of spontaneous psychological explanations was higher for anomalous-desire stories than for anomalous-belief stories ($F(1, 79) = 6.35$, $p < 0.01$; $\eta^2 = 0.07$). This effect was not confirmed when prompted psychological explanations were considered. Also the number of spontaneous desire-belief explanations produced for the three types of stories was significantly different ($F(2, 158) = 7.35$, $p < 0.001$; $\eta^2 = 0.08$). A test of within-subjects contrasts revealed that children's production of spontaneous desire-belief explanations for anomalous-desire stories was significantly higher than for neutral stories ($F(1, 79) = 12.77$, $p < 0.001$; $\eta^2 = 0.14$) and for anomalous-belief stories ($F(1, 79) = 8.58$, $p < 0.005$; $\eta^2 = 0.10$), respectively. When prompted desire-belief explanations were considered the effect of the three types of stories remained significant ($F(2, 158) = 3.33$, $p < 0.05$; $\eta^2 = 0.04$). A test of within-subjects contrasts revealed that children's production of complete desire-belief explanations for anomalous-desire stories was significantly higher than for anomalous-belief stories ($F(1, 79) = 7.22$, $p < 0.005$; $\eta^2 = 0.08$). That is, children explained all three types of stories using psychological explanations and the nested desire-belief explanations. However, they produced the highest number of psychological and desire-belief explanations for anomalous-desire stories even if this effect was weaker in children's prompted explanations. As would be expected, the prompt elicited in general the production of psychological explanations, reducing the difference between stories.

Children's production of false-belief explanations (for anomalous-belief stories) as well as their production of alternative-desire explanations (for anomalous-desire stories) was examined. Table 3 shows the frequency of answer, means and standard deviations of spontaneous and prompted false-belief and alternative-desire explanations produced by children.

False-belief explanations explained the protagonist's action, taking into account the discrepancy between the real state of affairs and the protagonist's action. Eleven percent of children (nine subjects) explained, at least once, the character's action using a spontaneous false-belief explanation and the 35% of them (28 subjects) did so using complete false-belief explanations. Alternative-desire explanations explained the protagonist's action, taking into account the discrepancy between the protagonist's preferences and his/her current action. Twenty-nine percent of children (23 participants) spontaneously explained the story, at least once, in terms of alternative desire, and 30% of them (24 participants) did so at least once with a prompt explanation.

In order to evaluate the relationship between children's false-belief explanations and alternative-desire explanations we considered children who used these

Table 3. Spontaneous and complete false-belief and alternative-desire explanations produced by children (frequencies and means (S.D.))

		Frequency of answer				
		3	2	1	0	*M* (S.D.)
Spontaneous	False belief	—	5 (6%)	4 (5%)	71 (89%)	0.18 (0.52)
	Alternative desire	3 (4%)	3 (4%)	17 (21%)	57 (71%)	0.60 (0.96)
Complete	False belief	7 (9%)	6 (7%)	15 (19%)	52 (65%)	0.40 (0.74)
	Alternative desire	3 (4%)	3 (4%)	18 (22%)	56 (70%)	0.41 (0.74)

two kinds of prompt explanations at least once. Fifty-one percent of children never gave an explanation in terms of false belief or alternative desire, while 16% of children were able to provide both of them at least once. Fourteen percent of children were able to explain an action in terms of alternative desire, but they did not provide an explanation in terms of false beliefs. Nineteen percent of children were able to explain an action in terms of false belief at least once but not in terms of alternative desires. A χ^2 revealed that the two kinds of explanations are significantly related ($\chi^2(1, N = 80) = 5.54$, $p < 0.05$). It is interesting to note that 67% of children were equally able to provide or not to provide the two kinds of explanations. Moreover, a correlation analysis showed that spontaneous false-belief explanations were positively correlated with both spontaneous alternative-desire ($r(80) = 0.44$, $p < 0.001$) and complete alternative-desire explanations ($r(80) = 0.43$, $p < 0.001$). In addition, complete false-belief explanations were positively correlated with both spontaneous alternative-desire ($r(80) = 0.35$, $p < 0.05$) and complete alternative-desire explanations ($r(80) = 0.36$, $p < 0.05$). Taken together, false-belief and alternative-desire explanations were of a comparable level of difficulty for children and were significantly correlated.

The Role of Perception- and Intention-Understanding in Children's Explanations

Seventy-four percent of children correctly reported in the perception-understanding task what they and the other person saw in three items out of three, showing a fully understanding of perception. Fifteen percent of children answered correctly two times out of three, 9% once and 2% did not give a single correct answer. The mean number of correct answers was 2.60 (S.D. = 0.76). Children's performance was not related to gender, birth order or the order of the questions.

Twenty-five of the children correctly answered all four items at the intention-understanding task, showing a full understanding of intention. Another 25% of the children correctly answered three items out of four, 31% two items, 18% only one item and 1% did not give a single correct answer. Thus, half of the sample answered correctly at a greater-than-chance expectation of 50%. The mean number of correct answers was 2.60 (S.D. = 1.10). Also children's performance in the intention-understanding task was not related to gender, birth order or order of items.

Children's use of psychological explanations, desire-belief explanations as well as alternative-desire and false-belief explanations was tested on the basis of their understanding of perception and intention. Children were sorted on the basis of the number of tasks they performed successfully. Fifteen children (19%) did not perform either the visual-perception or the intention-understanding task successfully, 45 children (56%) performed the visual-perception task but not the intention-understanding task successfully, and 14 children (15.5%) performed both successfully. Only a minority of the sample, consisting of six children (7.5%), succeeded in the intention-understanding task, but not in the perception task. Children were therefore assigned to three groups: Low = 'Perception−, Intention−'; Middle = 'Perception + Intention−'; and High = 'Perception+, Intention + '. The three groups were compared in order to evaluate their psychological, desire-belief, false-belief and alternative-desire explanations. We decided to report only the results relating to children's spontaneous explanations since analogous results were obtained for prompt
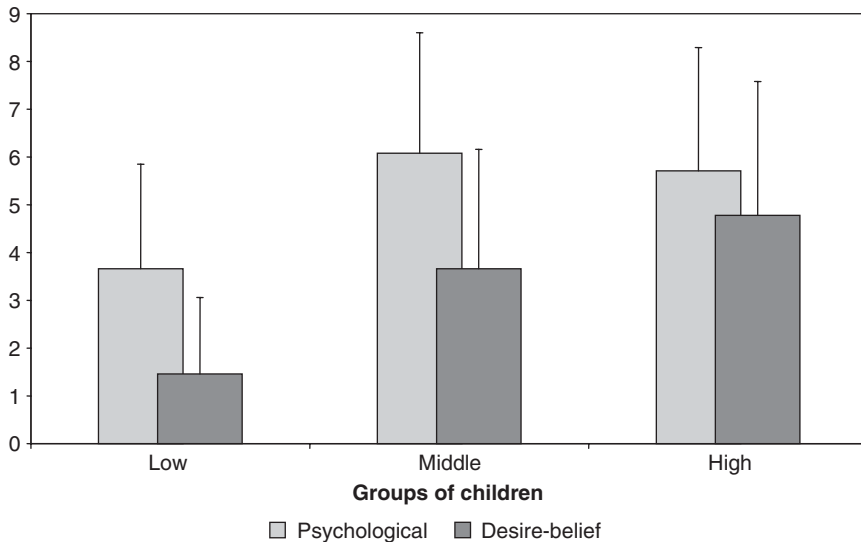
Figure 1. Psychological and desire-belief explanations produced by the three groups of children (means).

explanations. Figure 1 shows the means of the psychological and nested desire-belief explanations produced by the three groups of children.

The three groups of children produced a significantly different number of psychological explanations ($F(2, 71) = 5.45$, $p < 0.005$). A Tukey's test revealed that the middle group produced significantly more psychological explanations than the low group ($p < 0.01$). Moreover, a trend showed that the high group produced more psychological explanations than the low group ($p = 0.07$). The three groups of children also produced a significantly different mean number of desire-belief explanations ($F(2, 71) = 7.01$, $p < 0.005$). The Tukey's test showed that the low group produced significantly fewer spontaneous desire-belief explanations than the middle group ($p < 0.05$) and high group ($p < 0.005$). Thus, children's psychological explanations and, in particular, the nested desire-belief explanations were related to their understanding of perception and intentions.

As shown in Figure 2, the low group did not produce false-belief explanations. An ANOVA examining the production of false-belief explanations in the other two groups (middle and high) yielded no significant effect. Taken together, children with no full understanding of perception and intention did not explain the protagonist's action by considering the information about the real state of affairs in the story. Besides, children who succeeded in the intention-understanding task did not produce more false-belief explanations than children who failed in the task.

Just as for false-belief explanations, children who performed neither the perception nor the intention task successfully did not produce alternative-desire explanations. Thus, they never explained the protagonist's action by taking into account the information about the protagonist's preference. An ANOVA was conducted in order to evaluate whether there was a difference in the production of spontaneous alternative desires in the other two groups (middle and high). The result revealed that the two groups of children produced on average a
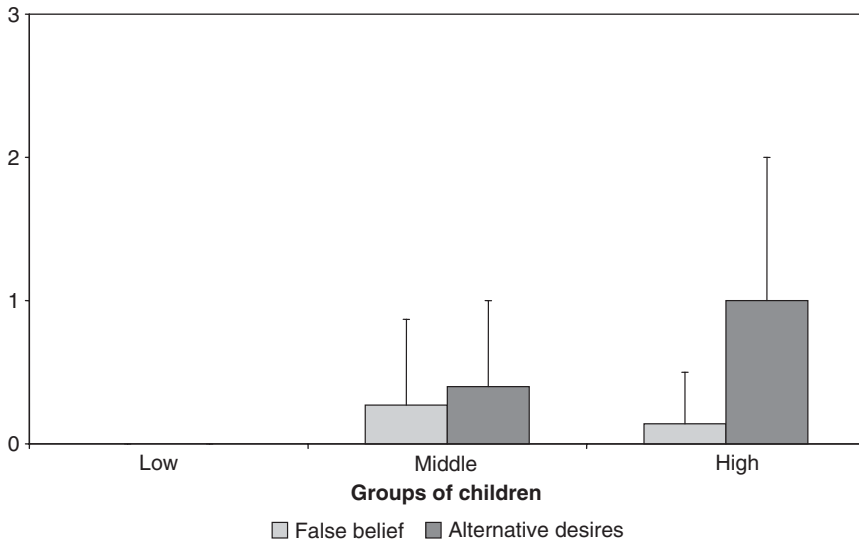
Figure 2. False-belief and alternative-desire explanations used by the three groups of children (means).

significantly different number of alternative-desire explanations ($F(1, 57) = 4.41$, $p < 0.05$). The high group produced significantly more alternative-desire explanations than the middle group. In sum, only children who were able to understand perception produced false-belief and alternative-desire explanations. Moreover, children who were able to understand intention produced a greater number of alternative-desire explanations.

DISCUSSION

The current study examined how young children explain human behaviour in a mentalistic way and investigated two different aspects of this ability. Our first aim was to evaluate children's psychological explanations and the nested desire-belief and false-belief explanations. Moreover, we explored children's desire explanations that took into account an inconsistency between the protagonist's preference and his/her action. We called these 'alternative-desire explanations'. Our second aim was to explore the relationship between psychological explanations and the understanding of perception and intention.

Our results confirm some previous studies (Bartsch & Wellman, 1989, 1995; Schult & Wellman, 1997; Wellman & Woolley, 1990) showing that young children preferred to use psychological explanations and above all desire-belief explanations instead of behavioural explanations in giving reasons for human behaviour. They do so, above all, when the preferences and the desires of someone else should be taken into consideration. This study also introduces some new evidence about children's production of desire and belief explanations. Indeed, children who were already able at the age of three years to explain others' behaviour in terms of false beliefs were also able to explain behaviour in terms of alternative desires. Moreover, the study shows a relationship between children's psychological explanation and their understanding of perception and intention.

In general, the understanding of perception and intention is related to a higher production of psychological and desire-belief explanation. In particular, the understanding of perception was an important prerequisite in order to explain others' behaviour in terms of false beliefs and alternative desires. Moreover, the understanding of intention was related to the ability to produce alternative-desire explanations.

In terms of children's psychological explanations, the prompt question always increased children's production of false beliefs. However, in coding children's explanations, we found that psychological meanings were often implicit in a child's spontaneous explanations. Below are two examples of our research in which an implicit false-belief explanation became explicit after the prompt question.

Example 1 (First Anomalous-Belief Story, The Kitten Story)

Child: It is here (she points at the chair) but she goes to look for it behind the table.
Adult: Why she is looking behind the table?
Child: Because if the kitty is here (she points at the chair) she should come here to take it.
Adult: What does she think?
Child: She thinks the kitty is here (she points at the table) but in fact the kitty is here. (She points at the chair)

Example 2 (Third Anomalous-Belief Story, The Balloon Story)

Child: Because he is going there to do that.
Adult: But why is he going to this store if they don't sell balloons there?
Child: Because he wants a balloon.
Adult: What does he think?
Child: He thinks they sell balloons but they don't.

On the basis of these examples, it could be argued that even if children were able to explain the character's false belief, they found it more natural to explain the character's behaviour in terms of desires or external justifications. Only when they were asked about the character's belief proposition was the false belief reported. This possibility supports the idea that three-year-olds may understand the false belief but prefer to give explanations in terms of desires.

In the present study only children's false-belief explanations were examined and not their false-belief predictions. In contrast, the original study of Bartsch and Wellman (1989) investigated both these two capacities, finding that children were much more competent in explaining others' behaviour than in predicting it. Several studies followed this first one in order to confirm (Robinson & Mitchell, 1995; Wellman & Banerjee, 1991) or dispute their finding (Clements & Perner, 1994; Wimmer & Hartl, 1991; Wimmer & Mayringer, 1998; Wimmer & Weichbold, 1994). We were interested in how children explain human behaviour when they do not produce a false belief, and for this reason we decided to examine only their explanation and not their prediction.

We found that the majority of children who were able to produce false-belief explanations were also able to produce alternative-desire explanations even though children's production of both these two kinds of explanations was poor. In explaining anomalous-belief stories, children often used the most simple

desire explanations or non-psychological explanations without taking into consideration the information about the nature or the presence/absence of the object. In the same way, in explaining anomalous-desire stories, children were more likely to use simple desires such as 'He wants to play with the frog', without taking into consideration the previous information about the protagonist's preferences.

Our results accord with the findings on three-year-olds' difficulty in understanding conflicting desires reported in Moore *et al.* (1995) and Rieffe *et al.* (2001). However, it is important to note an important difference between these studies. In the task developed by Moore *et al.* (1995) and Rieffe *et al.* (2001), children had to understand the conflict between their own desire and the desire of the character. In contrast, in the present task, children had to understand the contrast between the character's action and the same character's preference. In doing so, children were asked to interpret the action by producing an alternative desire that could not be directly connected to preferences or the action (e.g. 'She takes an apple because she likes apples', 'She takes an apple because she wants an apple'). Our result is consistent with the idea proposed by Astington and Gopnik (1991) that young children identify a character's desire with the current action. It could be argued that during the third year of life the ability to explain others' actions in terms of simple desires has already developed. However, the ability to explain others' actions in terms of desires that are implicit (i.e. desire that the child has to infer from other information) is still developing.

An effect due to the executive component of the task should also be considered (Moore *et al.*, 1995). In fact, it could be argued that the character's action is the strongest component of the story, and children could have difficulties in 'disengaging' from what the character is currently doing and the simple desire related to that action. We believe that further study of the nature of desires and how they can be comparable with beliefs is warranted.

Turning to the two hypotheses reported by Rakoczy *et al.* (2007) of symmetry or asymmetry in the development of the understanding of desires and beliefs, we argue for the symmetry hypothesis. Indeed, there are different levels in their development at which children can understand desires and beliefs. This process starts during infancy with joint attention and intentional communication. Children are already able to understand others' intention in the beginning of their second year of life, even if this does not mean they have a fully fledged adult level of intention-understanding. In any event, the early understanding of intention as well as joint attention are related to the later development of a theory of mind (Charman *et al.*, 2000; Olineck & Poulin-Dubois, 2005; Wellman, Phillips, Dunphy-Lelii, & LaLonde, 2004). In particular, Colonnesi, Rieffe, Koops, and Perucchini (2007), in a study related to the present study, found that the ability to follow the pointing gesture at 12 months of age predicts the later ability to explain others' behaviour in a psychological way and the perception understanding at the age of three years. Moreover, these authors found that the understanding of intention at the age of 15 months predicts the later understanding of intention at the age of three years. There are also later developments that follow the understanding of false beliefs (Lagattuta, 2005; Lillard, 2002; Moses, 2001; Nunez & Harris, 1998; Yuill, Perner, Pearson, Peerbhoy, & Emde, 1996; Zelazo, Astington, & Olson, 1999). In sum, there appear to be different levels of desire-, belief- and intention-understanding in childhood development, and these levels can be in a specific moment of the development comparable with each other.

With reference to the relationship between children's use of psychological explanations and their understanding of perception and intention, our results confirmed the hypotheses. Children who are able to understand perception produce more psychological explanations and the nested desire-belief explanations. Furthermore, the understanding of perception was a prerequisite for the production of false-belief and anomalous-desire explanations. The relationship between perception understanding and false-belief understanding has already been addressed in the literature (Gopnik *et al.*, 1994). Yet, the present study shows a relationship between perception understanding and the capacity to explain others' behaviour in terms of desires. Therefore, the ability to take into consideration the point of view of others is not only important in order to understand what somebody else sees and knows, but also to understand what somebody else prefers and wants to do.

Our results show a less evident relationship between children's intention-understanding and the use of psychological explanations. Moreover, no relationship was found between intention-understanding and false-belief explanations. This result is consistent with what Russell *et al.* (2001) found with children of the same age. However, a relationship between children's understanding of intentions and desires was found. Children able to understand intention produced a higher number of alternative-desire explanations. This result is consistent with Wellman's (1990) idea about the strong connection between desires and intentions, defining intentions as 'plans to actualize certain desires'.

The fact that the use of psychological explanations and the relationship with the understanding of perception and intention were examined only at the age of three years can be considered as a limitation of our study. We choose this age because this is the moment at which children start to explain others' behaviour in terms of desires and beliefs, showing the emergence of a theory of mind (Rakoczy *et al.*, 2007; Wellman, 1990; Wellman *et al.*, 2000). We wanted to see how early mentalistic reasoning is related to perception- and intention-understanding. Nevertheless, it is important to replicate the present investigation with children of four and five years of age in order to see how the production of alternative desires develops and to establish its relationship with false belief. Further research with older children would also be useful to better compare children's understanding of intention with their false-belief and inconsistent-desire explanations.

In general, two important results were found in the present study. The first is the fact that young children do not always find beliefs more difficult to incorporate into their explanations than desires. To explain others' behaviour in terms of desires that also take into consideration the information about the other person's preference is as difficult as to explain others' behaviour in terms of false beliefs. The second is that understanding of both perception and intention plays an important role in children's ability to explain others' actions.

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