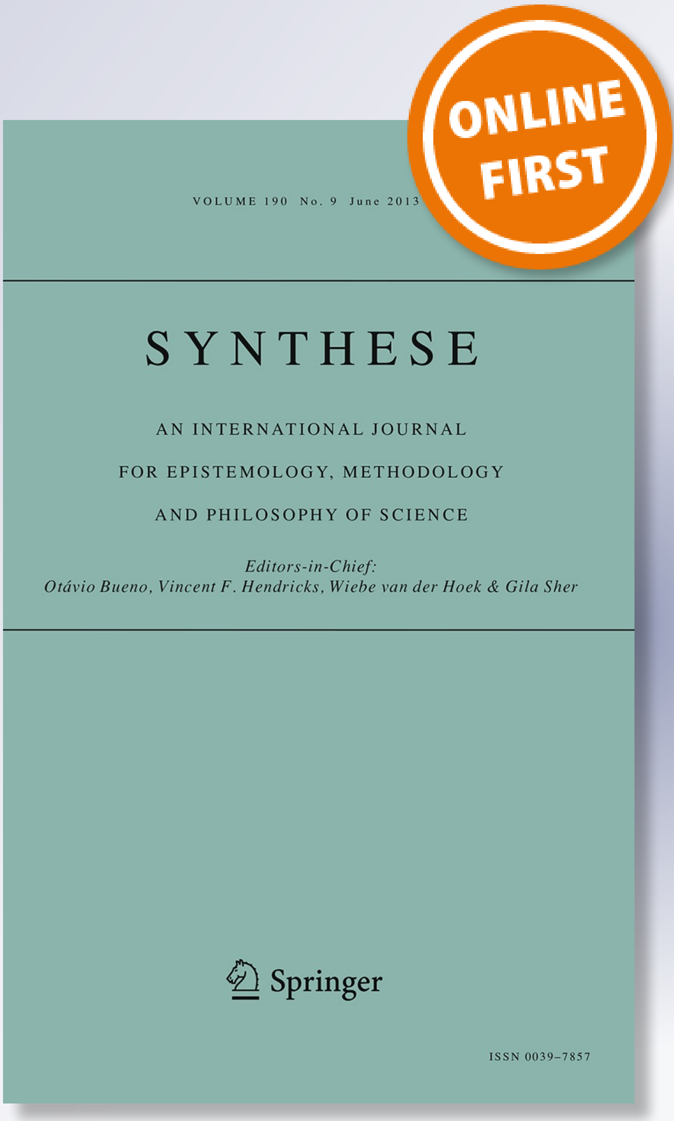
Mindreading with ease? Fluency and belief reasoning in 4- to 5-year-olds

Anika Fiebich

Synthese
An International Journal for Epistemology, Methodology and Philosophy of Science

ISSN 0039-7857

Synthese
DOI 10.1007/s11229-013-0301-5



Springer

Synthese
DOI 10.1007/s11229-013-0301-5

Mindreading with ease? Fluency and belief reasoning in 4- to 5-year-olds

Anika Fiebich

Received: 17 December 2012 / Accepted: 20 May 2013

Abstract For decades, philosophers and psychologists have assumed that children understand other people's behavior on the basis of Belief Reasoning (BR) at latest by age 5 when they pass the false belief task. Furthermore, children's use of BR in the true belief task has been regarded as being ontogenetically prior. Recent findings from developmental studies challenge this view and indicate that 4- to 5-year-old children make use of a reasoning strategy, which is cognitively less demanding than BR and called perceptual access reasoning (PAR), in true belief tasks. I appeal to research on fluency to explain these findings. On my account, 4- to 5- year-old children understand other people's behavior by means of BR if they experience cognitive strain (such as in false belief tasks) but they revert to simpler heuristics PAR when such an experience is missing (such as in true belief tasks).

Keywords Theory of mind · False belief task · True belief task · Belief reasoning · Perceptual access reasoning · Fluency

1 Introduction

What is the best indicator of understanding 'beliefs'? A widely-shared assumption is: an understanding of other people's *false* beliefs. As pointed out by Wellman, Cross, and Watson (2001, p. 655)

> mental-state understanding requires realizing that such states may reflect reality and may be manifest in overt behavior, but are nonetheless internal and mental, and thus distinct from real-world events, situations, or behaviors. A child's

A. Fiebich (✉)
Institut für Philosophie II, Ruhr-Universität Bochum, Universitätsstraße 150, 44780 Bochum, Germany
e-mail: anifiebich@gmail.com

> understanding that a person has a false belief—one whose content contradicts reality—provides compelling evidence for appreciating this distinction between mind and world.

For decades, philosophers and psychologists constantly assumed that children's explicit (i.e., conscious and linguistic) belief understanding is full-fledged developed at latest by age 5 when children perform successfully in the so-called 'false belief task'. Passing that task has been regarded as a milestone in children's 'theory of mind' that is the capacity to attribute mental states to others and to predict or explain the behavior of others by taking these states into account (also called 'mindreading').

A variety of 'false belief tasks' have been conducted since the early 80s, including the 'false location task', the 'false content task', and the 'false identity task'. In one version of the false location task, children were presented with a story in which the protagonist Maxi puts a chocolate bar into cupboard x. Then Maxi leaves the room. In his absence, Maxi's mother displaces the chocolate bar from cupboard x into cupboard y. Maxi returns. The children were asked to indicate the cupboard where Maxi will look for the chocolate bar. Only when the children are capable of representing Maxi's false belief ('chocolate bar is in x') apart from their own belief ('chocolate bar is in y') do they succeed in pointing correctly to x (Wimmer and Perner 1983). The 'false identity task' (also called 'appearance-reality distinction task') addresses children's ability to distinguish between the appearance and the real identity of an object. In one version of this task, Flavell et al. (1983) used a rubber that looks like a pencil. In the 'reality-first condition', the experimenter presented the real identity of the object to the child at first (e.g., the rubber pencil as bent, indicating its identity of being a rubber). In the 'appearance-first condition', in contrast, the experimenter first presented the appearance of the object (e.g., by presenting the rubber that looks like a pencil upright). Then, they asked the child how the object looks like and what it is in reality. Only children who identified the object's identity (of being a rubber) and appearance (of looking like a pencil) in both conditions passed the task. Finally, in the 'false content task' (also called 'representational change task'), children need to distinguish between their own past and present representations of the world, i.e., they need to grasp their own false belief. For example, Gopnik and Astington (1988) investigated this competency in children by, after presenting them a Smarties box, showing them that there are pencils in the box. Then the experimenters asked the children what they expected to be in the box: Smarties or pencils? Children who claimed that they had expected pencils to be in the box from the beginning failed the task whereas children who answered that they had expected Smarties passed it. A number of studies have shown that children typically pass each of these tasks by age 5 (see Wellman et al. 2001 for a review).

In contrast, children's true belief understanding has been regarded as ontogenetically prior to children's false belief understanding; some scientists even hypothesized that we attribute true beliefs in a default mode, and that it is due to children's inability to inhibit this default attribution in false belief tasks that 3-year-olds typically fail these tasks (e.g., Leslie 1987).

Furthermore, a number of theorists have proposed that children who perform successfully in any kind of belief task make use of a cognitive procedure called 'Belief Reasoning' (BR). In BR, children understand other people's epistemic states as representations, i.e., they are able to form meta-representations. Children understand that another person's epistemic states are nothing but an attempt to register objective states of the world, and that as such, they include the risk of failing to do so, i.e., of *misrepresenting* the states in question (Perner 1991). In order to conceive another person's epistemic state as *misrepresenting* particular state of affairs, children need to take into account how they themselves represent the state of affairs in question and they need to contrast their own representation with that of the other person. There is a broad consensus in the literature that building meta-representations is required to understand another person's *false* belief. Furthermore, BR enables children to predict or explain another person's behavior in terms of beliefs on the basis of folk psychological rules such as "if A wants p and believes that doing q will bring about p, then ceteris paribus, A will do q" (Borg 2007, p. 6).

In this paper, I point to empirical findings that challenge the traditional view that (i) 4- to 5-year-old children make use of BR in both explicit versions of the false belief task and the true belief task, and (ii) children pass true belief tasks by means of BR ontogenetically prior to false belief tasks. Furthermore, I suggest that fluency (i.e., the subjective experience of ease) plays a crucial role in 4- to 5-year-old children's reasoning about other people's beliefs.

In the next section, I start with a discussion of recent findings of Fabricius et al. (2010) on children's performance in true belief tasks as well as the authors' proposal of 'Perceptual Access Reasoning' (PAR) (rather than BR) as being involved in 4- to 5-year-olds' false and true belief understanding. In Sect. 3, I discuss the cognitive prerequisites of PAR compared to those of BR. Fabricius and colleagues successfully account for PAR as being involved in 4- to 5-year-olds' true belief understanding, but they fail to provide sufficient evidence to account convincingly for PAR as being involved in 4- to 5-year-olds' false belief understanding. This gives rise to a novel account of children's development of belief understanding that I outline in Sect. 4. On this account, 4- to 5-year-old children understand other people's behavior by means of BR if they experience cognitive strain (such as in false belief tasks) but they revert to simpler heuristics (PAR) when such an experience is missing (such as in true belief tasks).

2 Perceptual access reasoning (PAR)

In defense of a cognitive procedure called PAR according to which children link ignorance with incorrect behavior and knowledge with correct behavior, Fabricius and Khalil (2003; see also Hedger and Fabricius 2011 for a discussion) conducted a number of modified versions of the traditional false belief task. Basically, PAR is composed of two rules:

Rule 1: Seeing → Knowing (and Not Seeing → Not Knowing)
Rule 2: Knowing → Getting it Right (and Not Knowing → Getting it Wrong)

2.1 PAR in the false belief task?

According to Fabricius and Khalil (2003), children pass the false belief task by means of PAR rather than BR. On their account, children only perform successfully in false belief tasks, because the 'incorrect' alternative (e.g., searching for the chocolate bar in x) coincides with the alternative an agent would also have chosen on the basis of his or her false belief. To prove this hypothesis, Fabricius and Khalil removed this confound in a modified version of the false belief task. In the 'false location task', for example, they introduced a second 'wrong' response alternative to illustrate that children also choose this alternative, which makes an interpretation of children's successful performance in traditional false belief tasks by means of BR rather implausible and supports PAR.

However, Perner and Horn (2003) failed to replicate these findings. In their first experiment, Perner and Horn investigated 4- to 5-year-old children's performance in a false two-location task compared to a false three-location task. In each task children watched the protagonist putting an object in location A and leaving the scene. In the absence of the protagonist, another character arrived and removed the object from location A to location C (two-location version) or the child was asked in which of two locations the character should put the object (three-location version). After the child suggested one location (B), the story character put the object first there but then changed her mind and moved it to another location (C). Then the child was asked a series of questions (question 2 only in the three-location version); "1. Where is the <object> now? 'Location C'; 2. Where did you want to put the <object> at the beginning? 'Location B'; 3. Where was the <object> at the beginning? 'Location A'; 4. Who moved it to here (point to C)? 'second character'; 5. Could <protagonist> see that? 'no'; [. . . and finally 6.] Where will <protagonist> first look for the <object>? 'Location A"' (pp. 265–266). If children made use of PAR, they should have given more correct responses in the two-location version than in the three-location version. However, Perner and Horn have not found any significant differences in the number of children's correct responses in both task versions. They explain the discrepancy with their data to those of Fabricius and Khalil by pointing to two factors that should be kept separate: "(a) the effect of having more than two relevant locations or objects and (b) the effects of repeated questioning (barrage of three yes–no question)" (p. 270). On their view, children failed in the modified version of the 'false location task' in Fabricius' and Kahlil's study not because of PAR but rather because they were confused by a series of three yes–no questions about the character's and their own beliefs.

In their second experiment, Perner and Horn have tested the PAR hypothesis in the false content task. They replicated the two- and three-location tasks of the first experiment and tested 4- to 5-year-olds' understanding of the protagonist's thinking about the content of a box. In the 'neutral box condition' a plain box was used with two or three objects (e.g., a toy car, a key, and a pebble) whereas in the 'typical box condition' a typical box with a familiar content was used (e.g., a Smarties box) and the suggested content as one 'apparent object' (i.e., Smarties) together with one or two real objects (e.g., a pencil and a pebble). In the typical box condition, for example, the child was shown the box and asked what was inside. After the child gave the expected answer ('Smarties' = object A), the child was shown that the box contained another object B (e.g., a pencil). Whereas the story character put object B back in the two-object version, the character removed object B and put a different object C in the box in the three-object version. Then the child was asked a series of questions about what has been in the box (only in the two-object version), what is in the box now, who put a novel object inside the box, whether the protagonist has seen this and what the protagonist thinks is in the box. Contrary to the PAR hypothesis, Perner and Horn have found no difference in the number of children's correct responses in the two-object versus three-object version of the task. Intriguingly, however, they found that children performed significantly better in the typical box condition than in the neutral box condition as well as in the false location task than in the false content task. Perner and Horn speculate whether the children performed worse in the false content task because the question what the character thinks a box contains might be grammatically more taxing than the question where he will look for the object in the false location task.

Fabricius and Khalil (2003) propose that these puzzling findings might be due to salience differences of the alternatives by which children have been affected since in the neutral box task there is no physical reminder (e.g., the typical outer appearance of a Smarties box) of the first (false belief) object (e.g., the Smarties). On my view, low-level factors including salience difference may indeed account indeed for children's worse performance in the neutral box task compared to the typical box task (of course, this needs further empirical test).

Fabricius and Kahlil also point to relative salience to explain the discrepancy between their own results and those of Perner and Horn. On Fabricius and Kahlil's (2003) account, the open-ended questions asked by Perner and Horn fail to guarantee that the child has considered all three alternatives before answering whereas "relative salience may be less of an issue when children are asked a yes-no question about each alternative" (p. 256). On my view, this argument is not convincing and the result provided by Perner and Horn speaks convincingly against PAR being involved in 4- to 5-year-olds reasoning when passing the false belief task. In their questions, Perner and Horn (2003) make each alternative salient to the child (see above) and "the lack of any such evidence [in favor of the PAR hypothesis] is the more remarkable as the third location (B) was not only part of the story but was even the location suggested by the child herself as a possible hiding place" (p. 266). Following Perner and Horn, I assume that in Fabricius' and Kahlil's study children were confused by a series of three yes–no questions about the character's and their own beliefs. This constraint has been removed in a recent study on children's true belief understanding by Fabricius et al. (2010) who used only a single test question. This is why the results of this study strike me as being indicative for PAR being involved in 4- to 5-year-olds' true belief understanding.

2.2 PAR in the true belief task?

Fabricius et al. (2010) used only a single test question in a number of tasks that investigate whether children's true belief understanding is in accordance with PAR or not. According to PAR, 4- to 5-year-olds should not only perform at chance in the modified 3-location version from Fabricius and Khalil (2003) but also fail true belief tasks, which presuppose an understanding of the other's behavior in terms of beliefs and can only be solved by means of BR which is cognitively more demanding than PAR (see Sect. 3). Fabricius et al. (2010) conducted a number of tasks, including true belief versions of (i) the 'false content task', (ii) the 'false location task', and (iii) the 'false identity task'.

The *true belief version of the 'false content task'* has been conducted with 3- to 6.5-year-old children. In the false belief version, children were shown an M&M's bag and asked what they thought was inside, before they were shown that the bag contained a pencil. In the true belief version, children were shown the M&M's bag, asked what they thought would be inside, and then watched an experimenter showing to them that a pencil was inside, removing the pencil and filling the bag with M&M's. Then they were asked the test question: "what would the experimenter's friend Elmo, who was waiting outside the door, think the bag contains—a pencil or M&M's?" In one version of the *true belief version of the 'false location task'*, children watched a theatre including three toy figures representing a protagonist called Maxi, his sister Anna and his mother. Before leaving the room, Maxi watches his mother placing the chocolate in the red cupboard. In his absence, Maxi's sister takes the chocolate out of the cupboard, moves to the green cupboard, but then apparently changes her mind by returning the chocolate to its original location. The children were asked "when Maxi comes back to get his chocolate, where will he think it is?" (p. 1405; in italics in original) Finally, Fabricius et al. (2010) conducted a *true belief version of the 'false identity task'*. First, children were shown a sponge looking like a rock and asked what they thought it was. Afterwards, the children were allowed to touch the sponge and discover its real identity. Then the experimenter said "here is a real rock" by showing the children a similar-looking real rock. Finally, the children were asked what another person, who only looked at it, would think it is.

According to PAR, children consider whether someone does or does not have perceptual contact with the object in question, and consequently conclude whether he will be 'right' or 'wrong' about that object. In the true belief version of the 'false identity task', children using PAR should fail the task by assuming that the other child will be wrong about the object and think it is a sponge rather than a rock, because the other child lacks perceptual (here: tactile) experience to it. Children using 'Reality Reasoning' (RR), i.e., simply referring to the reality about an object based upon their *own* perceptual experience, in contrast, should pass the task as should children using 'Belief Reasoning' (BR), i.e., reasoning about the other's behavior in terms of beliefs (see Sect. 3). In the true belief version of the 'false location task', children using PAR should fail, assuming that Maxi should be wrong about the chocolate's location, because he faces a *new* situation in which he does not have perceptual access to the chocolate. Again, children using RR or BR should pass this task. In the true belief version of the 'false content task', children using PAR should again fail the task by reasoning that the other child, who has not seen the M&M's, does not know about the M&M's inside the bag. Thus, when forced to give a choice (pencil or M&M's?), children should conclude that the other child will be 'wrong' and think it is a pencil inside. Once again, children using RR or BR, in contrast, should pass the task.

As predicted by PAR, Fabricius et al. results of children's failure/success in passing the true belief task as well as their verbal justification for their answer indicated (as two independent methods) a U-shaped developmental pattern of performance in 'true belief-tasks': Whereas 3-year-olds passed the tasks by using RR and 6-year-olds passed by using BR, 4- to 5-year-olds failed by using PAR (see Fabricius and Khalil 2003 for similar results). In general, failing the 'false belief (content, location or identity) task' but passing its true belief version indicates the use of RR. In contrast, passing the false belief task but failing the true belief task indicates the use of PAR. Passing both tasks indicates the use of BR. In the true belief versions of the false content-, location-, and identity-task, children were asked for their justifications for their answers. For example, passing the true belief version of the 'false content task' but giving an incorrect answer (e.g., "because it has M&M's in it") indicates the use of RR, whereas passing the true belief task and giving the correct answer (e.g., "because it is a M&M's bag") indicates the use of BR. According to Hedger and Fabricius (2011, p. 434), "failing the task regardless of justification given is sufficient to indicate PAR, because that is the only approach that gives the incorrect answer to true belief tasks".

3 Cognitive demands in reasoning strategies: RR, PAR, and BR

On my view, the studies presented by Fabricius and Khalil (2003) and Fabricius et al. (2010) reviewed above provide one of the most intriguing contributions to the theory of mind debate that has been made in recent years. These results challenge the whole debate in its view that 5-year-old children make use of BR in any task that requires them to reason about another person's persistent epistemic states.

In this section, I explore the cognitive demands of the various reasoning strategies that children apply when they account for what another person's epistemic state about a particular state of affairs in the world is (e.g., an object's location, content, or identity) and how this epistemic state impacts his or her behavior. I take one strategy as cognitively 'more demanding' than another one dependent on the cognitive skills and competencies involved that are acquired throughout ontogeny. As I will show, Perceptual Access Reasoning is cognitively more demanding than Reality Reasoning but less demanding than Belief Reasoning.

In general, children's understanding of epistemic states is predicated on children's comprehension that sensual information (e.g., visual, manual, or auditory information) serves as a basis for epistemic state induction. Throughout ontogeny, infants' understanding of which kind of information serves as a proper basis for persistent epistemic-state induction in other people becomes more and more sophisticated, starting with an understanding of visual information in 13-month-olds (Surian et al. 2007), over manual information in 15-month-olds (Träuble et al. 2010) to verbal information in 18-month-olds (Song et al. 2008). Whereas infants exhibit sensitivity towards other people's persistent epistemic states already from 13th month onwards as indicated by their looking time or gaze direction, they start to refer explicitly to what another person 'thinks' about particular state of affairs in the world not before age 3. As we will see, children's understanding of another person's epistemic states (i.e., what another person 'thinks') develops gradually throughout ontogeny on the basis of various reasoning strategies.

In Reality Reasoning (RR), children simply account for another person's 'thinking' by referring to their *own persistent epistemic states* which are determined by their *own sensual information in the past*; for example, children think that an object is located at x because they have seen/heard/felt the object being located there. When reasoning about where another person 'thinks' the object to be and/or will search for the object in question, children refer to where they themselves think the object is 'really' located and hence would search for it. In RR, children do not differentiate between their own epistemic states and those of others whose behavior they are asked to predict or explain. RR presupposes memory capacities and meta-cognitive skills.

In PAR, in contrast, children refer to *another person's current epistemic states* which are determined by the *other's current sensual information*. In PAR, children take into account another person's current perceptual access to particular state of affairs in the world. That is, children determine which entities (persons, objects, or events) are in another person's acoustic or visual field (this has been called 'visual perspective taking level 1' by Flavell 1992) and recognize, for example, whether or not the other person sees/hears/feels where an object is located. Furthermore, children take into account the other person's current sensual information as basis for knowledge induction when reasoning about his or her behavior on the basis of two rules; rule 1: seeing → knowing (and not seeing → not knowing), and rule 2: knowing → getting it right (and not knowing → getting it wrong)) (see Sect. 2). Note that the criterion for correctness in 'getting it wrong/right' is the children's own persistent epistemic state about state of affairs in the world. For example, when a child recognizes that a person has no perceptual access to an object's location in a given situation and reasons by means of PAR that this person will 'get it wrong' when he or she attempts to approach that object, the child conceives as '*wrong*' that location where the child thinks the object is *not* located. That is, the child refers to his or her own persistent epistemic states about the object's location as a criterion of correctness. This again presupposes memory capacities and meta-cognitive skills. PAR does not presuppose, however, the capacity to build meta-representations. Hence PAR is cognitively less demanding than BR.

As already mentioned in Sect. 1, building meta-representations comes into play in Belief Reasoning (BR). In BR, children understand another person's persistent epistemic states as representations of objective states of the world. As such, representations involve the risk of failure; people may *misrepresent* state of affairs in the world. Furthermore, BR enables children to predict or explain another person's behavior on the basis of a folk psychological theory about what mental states such as 'beliefs' and 'desires' are, how they interrelate and motivate agents to act.

Following Zimmerman (2007, p. 63), I assume that the "the psychological theory through which the concept of belief is introduced is a deeply tacit one." We must therefore look to common assumptions about beliefs reflected in our naïve use of 'belief' to achieve any measure of success in the theory's articulation. Zimmerman argues for four platitudes of attributing a belief to another person, which we can extract from our everyday practices and which play a crucial role in our behavior prediction and explanation:

(1) *The Platitude(s) of Cause* a subject S typically believes that p if (s)he has available undefeated epistemic reasons for believing p, and S will lose that belief if (s)he has available contrary evidence in regard of p (e.g., seeing S with looking at a red apple in front of him or her, we assume that S believes that there is an apple in front of him or her, and that S loses that belief if the apple is taken away);
(2) *The Platitude of Inference* if S believes that p, (s)he typically believes propositions that follow from p (e.g., we assume that S not just believes that there is an apple in front of him or her, but also that there is something edible in that location, something plucked from a tree, and so on);
(3) *The Platitude(s) of Emotion* if S believes that p then (s)he will feel surprised if (s)he finds out that not p, and if S wants/hopes/wishes that p, (s)he will feel good upon coming to believe that it will be the case that p, and (s)he will feel bad upon coming to believe that it will not be the case that p (e.g., knowing that S believes that team A won't win the game, I can infer that S will be surprised if A wins);
(4) *The Platitude of Effect* S typically believes that p, if p represents an available way X to satisfy S's desires and S is disposed to act in a way X; e.g., if we know that S wants nothing more than to drink a beer and walks to the refrigerator, we can assume that S believes that the best way to get a beer is by walking to the refrigerator, in which some bottles of beer are stored).

A brief analysis reveals that these platitudes adequately capture the conceptual use of 'belief' of scientists when interpreting children's successful performance in the false-belief task as evidence of children's comprehension of another person's (false) belief. From a traditional viewpoint, in order to pass the false belief task, children need to be able to use the *platitudes of cause* of attributing a (false) belief to another person, i.e., children attribute a (false) belief to another person because they assume that this person has good epistemic reasons for a particular belief about an object's location (e.g., Maxi has good epistemic reasons that the chocolate bar is in the red cupboard, because he has seen it hidden there), content (e.g., a peer has good epistemic reasons to believe that M&M's are in the M&M's bag, because usually there are M&M's in a M&M's bag), or identity (e.g., a peer has good epistemic reasons to belief that the sponge-looking rook is a real rock, because it looks like a rock). Furthermore, passing the 'false location task', also presupposes the use of the *platitude of effect*; Maxi wants to eat the chocolate bar and thinks the best way to satisfy this desire is to go to the red cupboard where he (falsely) believes the chocolate bar in. Being able to use the platitude of effect of attributing a belief to Maxi, children are capable to predict that Maxi will search for the chocolate in the red cupboard (and if children are additionally able to use the *platitudes of emotion* of attributing a belief to Maxi, they can predict correctly that Maxi will be surprised when he does not find the chocolate bar in the red cupboard).

According to Fabricius and Khalil (2003), however, children's successful performance in false belief tasks is due to children's intimately connected concepts of 'knowing/not knowing' and 'getting it right/getting it wrong' rather than an understanding of 'belief' that involves the use of the platitudes discussed above. As pointed out by Hedger and Fabricius (2011), "*knowing* in PAR is caused by what the person has perceptual access to in the current situation, and both perceptual access and hence knowing change as the situation changes" (p. 432, italics added). Thus 'knowing' in PAR comes close to the *platitude of cause* of belief attribution described above, and Fabricius et al. (2010) even explicitly state that "the perceptual access hypothesis also includes a central role for understanding causal relations among different mental states [... such as] *seeing causes knowing*" (p. 1415, italics added); thus according to PAR, a subject S typically *knows* that p if she has available undefeated epistemic reasons for knowing p. Crucially, however, unlike the attribution of belief, 'undefeated epistemic reasons for *knowing* p' are restricted to the current perceptual access in a given situation, i.e., *current* epistemic states rather than *persistent* epistemic states—hence, as soon as a person loses that access, he or she also loses the knowledge that p. This leads to rule 1 of PAR: seeing/not seeing → knowing/not knowing. Furthermore, 4- to 5-year-olds have not yet differentiated 'knowing/not knowing' and 'getting it right/getting it wrong' (Ruffman 1996), which leads to rule 2 of PAR: knowing/not knowing → getting it right/getting it wrong. "Thus PAR entails the prediction that children will judge that a protagonist will get it wrong regardless of whether the protagonist has a false belief or a true belief, as long as the situation in both cases result in comparable lack of perceptual access" (Hedger and Fabricius 2011, p. 432).

To sum up, RR, PAR, and BR presuppose memory and meta-cognitive skills about one's own persistent epistemic states about particular state of affairs in the world. Furthermore, PAR requires an understanding of the other person's current epistemic state by taking into account which sensual information the other person possess on the basis of his or her current perceptual access to state of affairs in the world (e.g., by visual perspective-taking level 1). In PAR, the criterion for correctness in 'getting it wrong/right' is the children's own persistent epistemic state about state of affairs in the world. Finally, BR requires not only an understanding of the other person's current epistemic state (e.g., does Maxi perceive cupboard x where he believes the chocolate to be located?) but also the other person's persistent epistemic states (e.g., where has Maxi perceived the chocolate being hidden?) as representations of state of affairs in the world, i.e., the capacity to build meta-representations, which involves the risk of misrepresentation (e.g., Maxi believes the chocolate to be in cupboard x although it has been replaced into cupboard y).

Developmental studies suggest that 3-year-old children make use of RR in any kind of belief task (see Wellman et al. 2001; Fabricius et al. 2010 for a discussion). Furthermore, there is a broad consensus in the literature that children make use of BR in both true and false belief tasks from age 5 onwards. In contrast, Fabricius and Khalil (2003) argued for PAR as cognitive procedure being involved in 4- to 5-year-olds' successful performance in false belief tasks by running a set of modified versions of the traditional false belief tasks (see Sect. 2.1.). For example, they introduced a second 'wrong' response alternative where the object the agent is searching for is *not* hidden in the 'false location task'. Since children also chose this alternative, the scientists argued that children made use of PAR rather than BR. However, recall that Perner and Horn (2003) failed to replicate Fabricius' and Khalil's findings, and notice that within the past 10 years, Fabricius and colleagues did not succeed in publishing a follow-up study in order to support their hypothesis of PAR being the cognitive procedure that underlies children's successful performance in false belief tasks.[1] In contrast, Fabricius et al. (2010) provide convincing evidence in a series of experiments that an understanding of the other's behavior in terms of 'beliefs', understood as the capability to use the different platitudes of attributing beliefs discussed above, is probably not used by children younger than age 6 when they pass true belief tasks. This suggests that contrary to what has been traditionally presumed, 4- to 5-year-olds make use of *different* cognitive procedures when understanding another person's 'false belief' opposed to understanding another person's '(true) belief'. Basically, I agree with Hutto (2008, p. 26 ff., italics in original) that false belief tasks "do precisely what their name suggest *and nothing more*—that is, they test for an explicit understanding of false beliefs". Developmental research suggests that whereas 4- to 5-year-old children make use of BR in false belief tasks, they are engaged in PAR in true belief tasks.

4 The role of fluency in reasoning processes

Why do 4- to 5-year-old children use different strategies when reasoning about another person's epistemic state in false belief tasks opposed to true belief tasks? I appeal to empirical research on 'fluency' to answer this question.

In general, 'fluency' is defined as "the subjective experience of ease or difficulty associated with completing a mental task" (Oppenheimer 2008, p. 237). A number of studies have shown that fluency impacts which procedure individuals use to solve a mental task; whereas individuals draw on simple strategies that involve fast, heuristic and relatively effortless reasoning processes when they experience cognitive ease, they make use of more complex, cognitively demanding and effortful strategies when a particular task appears to be difficult to them to solve, i.e., when they experience cognitive strain.

Following Kahneman (2011, p. 60), I propose that the experience of cognitive ease depends on various variables such as repeated experience, a clear display, a primed idea, or a good mood and is characterized by feelings of familiarity, trueness, goodness, and effortlessness. For example, 'fluency' in these tasks can be modulated by presenting the participants the task in an easy-to-read font opposed to a difficult-to-read font. Alter et al. (2007), found that when participants need to solve a mental task (e.g., "A bat and ball cost $1.10 in total. The bat costs $1 more than the ball. How much does the ball cost?"), participants were more likely to override their intuitive response ("10 cents") and to respond correctly ("5 cents") by means of a higher-level reasoning procedure when they read the task in a difficult-to-read font. The authors concluded that the experience of difficulty or cognitive strain activates analytic forms of reasoning by means of which people can correct the outcomes of their intuitive reasoning processes.

Another analysis of the so-called 'Cognitive Reflection Test' (CRT) that requires participants to override their intuitive response suggests that participants consciously

[1] Of course, the fact that Fabricius and Khalil's (2003) study has not been replicated (yet) is only an indicator but does not mean necessarily that it is not replicable. I dismiss their findings because Perner and Horn (2003) failed to replicate it and because Perner's and Horn's assumption that the children in the study by Fabricius and Khalil were confused by a series of yes–no questions strikes me as plausible.

overrode their intuitive response. "For example, those who answered 10 cents to the 'bat and ball' problem estimated that 92 % of people would correctly solve it, whereas those who answered '5 cents' estimated that 'only' 62 % would. (Both were considerable overestimates.) Presumably, the '5 cents' people had mentally crossed out 10 cents and knew that not everyone would do this, whereas the '10 cents' people thought the problem was too easy to miss" (Frederick 2005, pp. 27–28).

In line with Kahneman's (2011) two-system approach to (social) cognition, I propose that reasoning processes that are experienced with cognitive ease rely on a cognitive System 1, whereas reasoning processes that are experienced with cognitive strain rely on a cognitive System 2. The cognitive processes of System 2 are slow, flexible routines, which require the expenditure of mental effort and are subject to consciousness and deliberative control. In contrast, the cognitive processes of System 1 are fast, relatively inflexible routines that may occur without awareness. In general, people are prone to make judgments on the basis of reasoning processes that require least cognitive effort, i.e., they tend to make judgments on the basis of strategies that involve fast, heuristic and relatively effortless reasoning processes (System 1). For example, when people are confronted with a target question (e.g., "How happy are you with your life these days?"), they tend to answer a heuristic question instead ("What is my mood right now?"). As mentioned above, the experience of cognitive strain serves as a means for individuals to enter effortful cognitive reasoning processes to address the target question.

Fluency may also impact children's choice between different reasoning strategies about what the epistemic states of an agent are and how these states impact the agent's behavior. When confronted with the target question "What does the agent think about x?", 4- to 5-year-olds may have a tendency to answer the heuristic question "Has the agent perceptual access to x?" instead. That is, I propose that 4- to 5-year-old children are prone to make use of simple heuristics (i.e., PAR) even though they are capable of making use of higher-level reasoning strategies (i.e., BR).

Recall that PAR is cognitively 'cheaper' than BR since it only requires taking into account the agent's current (but not persistent) epistemic states about state of affairs in the world by determining the current perceptual access of the agent to the state of affairs in question. 4- to 5-year-old children's tendency to rely on simple heuristics (PAR) when reasoning about other people's thinking is evident in their performance of true belief tasks. At the same age, however, children make use of a cognitively more 'costly' procedure (BR) in false belief tasks that involves accounting for the persistent epistemic states of the agents as well as building of meta-representations. Finally, this procedure relies on a concept of 'thinking' or 'believing' that involves a complex set of platitudes (see Sect. 3). I propose that 4- to 5-year old children make use of BR in false belief tasks due to an experience of cognitive strain that is absent in true belief tasks.

As already indicated, cognitive strain can be induced by a variety of impact factors (e.g., an unclear display). Also 'cognitive dissonance' has been found to induce cognitive strain. 'Cognitive dissonance' is a feeling of discomfort when simultaneously holding conflicting cognitions such as beliefs or values (Festinger 1957) and has been discussed in the framework of two-system theories (see e.g., Gawronski and Strack 2004). Individuals who experience cognitive dissonance due to conflicting own cognitions typically seek to balance the experienced conflict by rationalizing or re-evaluating things. For example, cult members, who believed that a UFO landing was imminent and they alone would survive the Earth's destruction, experienced cognitive dissonance when the expected event did not occur. However, instead of taking this as evidence for the non-existence of UFO's or the incredibility of the cult's prophecies, the cult members sought for less dissonant explanations to their beliefs such as 'the aliens had given earth a second chance' (still holding that aliens exist). Furthermore, individuals who experience cognitive dissonance have been found to re-evaluate the likeability of an object A over another object B after they have chosen object A in a free-choice paradigm (see Harmon-Jones and Mills 1999 for a discussion).

On my hypothesis, reasoning about the agent's belief is cognitively more effortful in false belief tasks than in true belief tasks for 4- to 5-year-old (though not older) children. 4- to 5-year-old children experience cognitive dissonance in reasoning processes in false belief tasks in which their own belief (i.e., persistent epistemic state) differs from that of the agent but not in true belief tasks in which there is no such difference. I postulate that this experience of cognitive dissonance is accompanied by an experience of cognitive strain that places 4- to 5-year-old children on higher-cognitive levels of reasoning. In line with the literature on fluency reviewed above, I propose that the experience of cognitive strain in false belief tasks leads children to make use of BR, whereas children make use of PAR (which is cognitively 'cheaper' than BR) in true belief tasks where such an experience is missing. Finally, I propose that later on in ontogeny, 6-year-old children make use of a concept of 'belief' when reasoning about another person's epistemic states about an object's location from those of someone else, even if these states do not differ in content. At that age, children do not seem to be prone to make use of PAR anymore. Rather, they seem to make use of BR with ease. Recall that one factor to experience cognitive ease is repeated experience and learning. Whereas individuals may initially need to be engaged in effortful reasoning processes to pass a task (in social cognition or other areas), their reasoning processes decrease in cognitive effort when they become experienced in meeting similar tasks; that is, whereas 'mindreading' by means of BR might be effortful initially for 4- to 5-year-old children, it becomes easier to them by repeated experience when they grow older.

Unfortunately, little research has been done on fluency and cognitive dissonance in infancy. In a welcome exception, Egan et al. (2007) found recently that cognitive dissonance is present already in 4-year-olds. In a free-choice paradigm, 4-year-old children who were asked to make a choice between two equally desirable alternatives (two different stickers and two differently colored M&M's, respectively) deemed the unchosen alternative as less valuable later on. The authors argued for cognitive dissonance as explaining these results and proposed age 4 to be the ontogenetic origin of the experience of cognitive dissonance.

4.1 Outline of experimental paradigms

As yet, my account relies on theoretical considerations and is hypothetical in nature. Hence the primary intent of this paper is to gain the interest of developmental psychologists in testing my hypothesis empirically. One way of doing so is to test whether 4- to 5-year-olds experience indeed cognitive strain when reasoning about the story character's belief in false belief tasks but not (or less) in true belief tasks. Increased heart rates or pupil sizes might serve as an indicator for the experience of cognitive strain (Kahneman 2011). Another way of doing so is to replicate the true belief tasks that have been conducted by Fabricius et al. (2010) in a modified version by introducing some variables that induce cognitive strain. If the results in this experiment would show that 4- to 5-year-olds pass Fabricius et al. true belief tasks in the modified but not in the original versions (i.e., in the more difficult versions), this could be regarded as support for my hypothesis that 4- to 5-year-olds only make use of BR when reasoning about other people's epistemic states when they experience cognitive strain but revert to simpler heuristics when such an experience is missing.

5 Summary and outlook

Recent evidence from developmental psychology suggests that 4- to 5-year-old children use a cognitively less demanding strategy (PAR) in true belief tasks than they make use of in false belief tasks (BR). To explain these striking findings I appeal to research on fluency and cognitive dissonance. In line with this literature, I propose that BR is present already in 4- to 5-year-olds but that 4- to 5-year-old children make use of BR initially locally rather than globally, i.e., just in situations in which they experience cognitive strain when reasoning about an agent's behavior whose beliefs (and hence behavior) differ from their own. If such an experience is missing, children revert to a less cognitively demanding strategy (PAR) than BR. On my account, 4- to 5-year-old children's awareness of a discrepancy between their own beliefs and those of someone else makes them experiencing cognitive strain which places them on higher-cognitive levels of processing. This account succeeds in integrating Fabricius et al. (2010) findings into a coherent picture of children's 'theory of mind'. On my view, Fabricius et al.'s findings belong to the most intriguing findings in the theory of mind debate that have been made in recent years and deserve closer attention of other scientists. In general, the findings reviewed above indicate that children's successful performance in 'theory of mind tasks' seems to be closely tied to a conceptual knowledge of what the agent's epistemic states (about an object's location, identity, or content) are and how these states motivate the agent to act. That is, children seem to use a 'theory' when reasoning about other people's epistemic states such as proposed by theory theorists. In line with theory theorists and the developmental research reviewed above, I propose that we continuingly revise our theories about how minds work (Gopnik 1988). That is, theory 1 (RR) is replaced by theory 2 (PAR) over time, and then theory 2 (PAR) is replaced by theory 3 (BR). On this view, once PAR is fully in place in 4- to 5-year-old children, they do not revert to RR anymore. In this paper, I proposed that PAR is replaced by BR in false belief tasks due to the experience of cognitive strain. Note that I have not made any claims about how RR is replaced by PAR in younger children.

That children make use of theories in theory of mind tasks means in no way that theory use should be regarded as the best or even only procedure that underlies people's social understanding in any context of everyday life. Indeed, I favor a pluralistic approach to social understanding according to which individuals make use of multiple cognitive procedures (e.g., theory, or simulation) when it comes to predicting or explaining other people's behavior dependent on individuals' cultural background, the contextual features of the particular situation of social understanding, and their cognitive competencies.

Acknowledgments I would like to thank Cameron Buckner, Albert Newen, Danny Oppenheimer and two anonymous reviewers for helpful comments on a previous version of this paper. Furthermore, I acknowledge the financial support provided by the Barbara-Wengeler-Foundation during the initial stages of this paper as well as ongoing support from the VW-project "The Social Mind".

References

Alter, A. L., Oppenheimer, D. M., Epley, N., & Eyre, N. (2007). Overcoming intuition: Metacognitive difficulty activates analytic reasoning. *Journal of Experimental Psychology: General*, *136*(4), 569–576.

Borg, E. (2007). If mirror neurons are the answer, what was the question? *Journal of Consciousness Studies*, *14*, 5–19.

Egan, L. C., Santos, L. R., & Bloom, P. (2007). The origins of cognitive dissonance. *Psychological Science*, *18*(11), 978–983.

Fabricius, W. V., & Khalil, S. L. (2003). False beliefs or false positives? Limits on children's understanding of mental representation. *Journal of Cognition and Development*, *4*, 239–262.

Fabricius, W. V., Boyer, T., Weimer, A. A., & Carroll, K. (2010). True or false: do five-year-olds understand belief? *Developmental Psychology*, *46*, 1402–1416.

Festinger, L. (1957). *A theory of cognitive dissonance*. Stanford: University Press.

Flavell, J. H. (1992). Perspectives on perspective-taking. In H. Beilin & P. Pufall (Eds.), *Piaget's Theory: Prospects and Possibilities* (pp. 107–139). Hillsdale, NJ: Erlbaum.

Flavell, J. H., Flavell, E. R., & Green, F. L. (1983). Development of the appearance-reality distinction. *Cognitive Psychology*, *15*, S.95–S.120.

Frederick, S. (2005). Cognitive reflection and decision making. *Journal of Economic Perspectives*, *19*(4), 25–42.

Gawronski, B., & Strack, F. (2004). On the propositional nature of cognitive consistency: Dissonance chances implicit but not explicit attitudes. *Journal of Experimental Social Psychology*, *40*, 535–542.

Gopnik, A., & Astington, J. W. (1988). Children's understanding of representational change and its relation to the understanding of false belief and the appearance-reality distinction. *Child Development*, *59*, 26–37.

Harmon-Jones, E., & Mills, J. (1999). An introduction to cognitive dissonance theory and an overview of current perspectives on the theory. In E. Harmon-Jones & J. Jones (Eds.), *Cognitive dissonance: Progress on pivotal theory in social psychology* (pp. 3–21). Washington, DC: American Psychological Association.

Hedger, J. A., & Fabricius, W. V. (2011). True belief belies false belief: Recent findings of competence in infants and limitations in 5-year-olds, and implications for theory of mind development. *Review of Philosophy and Psychology*, *2*, 429–447.

Hutto, D. D. (2008). *Folk Psychological Narratives: The sociocultural basis of understanding reasons*. Cambridge, MA: Bradford Books MIT Press.

Kahneman, D. (2011). *Thinking, Fast and Slow*. London: Penguin Books.

Leslie, A. M. (1987). Pretense and representation: The origins of 'theory of mind'. *Psychological Review*, *94*, 412–426.

Oppenheimer, D. M. (2008). The secret life of fluency. *Trends in Cognitive Sciences*, *12*(6), 237–241.

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

Perner, J., & Horn, R. (2003). Knowledge or false negatives: Do children of 4 to 5 years simulate belief with "not knowing = getting it wrong?". *Journal of Cognition and Development*, *4*, 263–273.

Ruffman, T. (1996). Do children understand the mind by means of simulation or a theory? Evidence from their understanding of inference. *Mind and Language*, *11*, 388–414.

Song, H.-J., Onishi, K. H., Baillargeon, R., & Fisher, C. (2008). Can an agent's false belief be corrected by an appropriate communication? Psychological reasoning in 18-month-old infants. *Cognition*, *109*(3), 295–315.

Surian, L., Caldi, S., & Sperber, D. (2007). Attribution of beliefs by 13-month-old infants. *Psychological Science*, *18*, 580–586.
Träuble, B., Marinovic, V., & Pauen, S. (2010). Early theory of mind competencies: Do infants understand others' beliefs? *Infancy*, *15*(4), 434–444.
Wellman, H. M., Cross, D., & Watson, J. (2001). Meta-analysis of theory-of-mind development: the truth about false belief. *Child Development*, *72*, 655–684.
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.
Zimmerman, A. Z. (2007). The nature of belief. *Journal of Consciousness Studies*, *14*, 61–82.