Synthese
DOI 10.1007/s11229-015-0860-8

S.I. : FUTURE OF SOCIAL COGNITION

# In defense of a developmental dogma: children acquire propositional attitude folk psychology around age 4

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Received: 18 December 2014 / Accepted: 8 August 2015


**Abstract** When do children acquire a propositional attitude folk psychology or theory of mind? The orthodox answer to this central question of developmental ToM research had long been that around age 4 children begin to apply "belief" and other propositional attitude concepts. This orthodoxy has recently come under serious attack, though, from two sides: Scoffers complain that it over-estimates children's early competence and claim that a proper understanding of propositional attitudes emerges only much later. Boosters criticize the orthodoxy for underestimating early competence and claim that even infants ascribe beliefs. In this paper, the orthodoxy is defended on empirical grounds against these two kinds of attacks. On the basis of new evidence, not only can the two attacks safely be countered, but the orthodox claim can actually be strengthened, corroborated and refined: what emerges around age 4 is an explicit, unified, flexibly conceptual capacity to ascribe propositional attitudes. This unified conceptual capacity contrasts with the less sophisticated, less unified implicit forms of tracking simpler mental states present in ontogeny long before. This refined version of the orthodoxy can thus most plausibly be spelled out in some form of 2-systems-account of theory of mind.

**Keywords** Theory of mind · Social cognition · Intensionality · Cognitive development

When in ontogeny do children acquire a folk psychology or "theory of mind" (ToM)—the conceptual framework of propositional attitudes with which we describe and explain each other? This central question of developmental ToM research has been dis-

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Published online: 05 September 2015

cussed in the field for over three decades now, and what had come to be the traditional, orthodox answer was that children acquire a ToM in the course of an overarching cognitive revolution around age 4 (Perner 1991; Wellman et al. 2001). While relatively undisputed a while ago, this orthodoxy, however, has recently come under serious attack from two opposing sides—the critique being that it is too conservative or too liberal, respectively. The rationale of the current paper is the following: first of all, the claims and the empirical basis of the orthodoxy will be introduced in more detail. I will then closely examine the logic and the empirical grounds of the two attacks. In the course of doing so, I will review new evidence (partly from our lab) that speaks to these attacks—evidence that, in fact, helps to show how the orthodoxy can safely survive the attacks. The conclusion will thus be a defense of the orthodox claim—but not a purely reactionary move: the result of the defense will be a suitably refined version of the orthodoxy, one along the lines of recent conceptual expansion accounts of ToM.

## 1 The orthodox claim and its empirical basis

At the heart of our folk psychology lie the concepts of propositional attitudes such as belief and desires. Empirically, what counts as convincing evidence that a creature operates with such concepts? From the beginning of ToM research, there has been wide-ranging consensus that what are needed to demonstrate the use of propositional attitude concepts are tasks that require a subject to understand that agents represent the world from their specific subjective points of view—that is, potentially differently from the ways in which others represent it, and potentially inaccurately (Bennett 1978; Dennett 1978; Harman 1978). Therefore, false belief (FB) tasks, tapping an understanding of a protagonist's inaccurate or mis-representation (Wimmer and Perner 1983), level II perspective-taking tasks (tapping an understanding that people can view the same thing differently; (Flavell et al. 1981) and related tasks have come to be considered litmus tests for ToM. Empirically, what decades of research with such tasks have documented is the following [for review, see Perner and Roessler (2012), Wellman et al. (2001)]. First, competence in a huge variety of such tasks, differing widely in topic, format and surface structure, emerges in close synchrony around age 4. Second, competence in such tasks is significantly correlated, even when controlling for age and other extraneous factors. Third, competence in such tasks depends on domain-general cognitive capacities such as executive function and language. On the basis of these findings, what has come to be the orthodox opinion in developmental ToM research is that these convergent findings indicate the emergence of a common, underlying novel conceptual capacity: the acquisition of the conceptual scheme of beliefs and other subjective, perspectival propositional attitudes (e.g., Perner 1991).

## 2 The orthodox claim under attack

As it typically happens to orthodoxies, recently this claim has come under attack from opposing ends of the ideological spectrum. Boosters criticize the orthodoxy as too conservative. In particular, spectacular new findings in the last ten years with implicit tasks suggesting some ToM competence long before age 4 (Onishi and Baillargeon

2005; for an verview see Baillargeon et al. 2010) have been the basis for claims that the orthodox view rests on inappropriate tests that vastly underestimate early competence. This attack is well known and has led to what is probably the most central theoretical debate in current ToM research to which we will turn shortly.

## 2.1 Scoffer attacks

The scoffer attack from the opposing ideological end, in contrast, is much less well-known though it is even older and its empirical basis seems no less solid (e.g. Lalonde and Chandler 2002; Fabricius et al. 2010). The basic line of scoffer reasoning is this: while standard FB and related tasks are certainly solved by the use of proper propositional attitude concepts by adults, this does not mean that 4-year-olds already need to solve them in the same way. Unless we have independent evidence from other tasks that children positively do understand essential properties of propositional attitudes, it might be too hasty to assume that a conceptual scheme of propositional attitudes develops around age 4.

### *2.1.1 Two manageable scoffer attacks*

Three lines of scoffer attacks have been influential: The first line has argued that children do not understand the essentially constructive nature of mental states until much later (Lalonde and Chandler 2002). For example, children seem to have difficulty understanding that vastly ambiguous stimuli can yield diverging perceptual interpretations in different viewers—suggesting that they do not grasp the subjectivity of mind in adult-like ways yet. A second line has argued, on methodological grounds, that standard FB tests can be solved by multiple strategies and that 4-year-olds might master them by using a simpler strategy than proper FB reasoning (Fabricius et al. 2010; Hedger and Fabricius 2011). These two lines of attack, it seems, are interesting, but not damaging to the orthodoxy. The first line may well be true, but does not put into question the orthodox position: True, children might come to understand subjectivity in the sense of constructiveness pertaining to mental states only later—but this fact about understanding a very specific form of subjectivity (that seems not essential to an understanding of propositional attitudes generally, and of which it is not even clear to what except perception in actually applies) does obviously not mean that young children fail to understand the more basic subjectivity and perspectivalness that is essential to propositional attitudes. The second line essentially rests on a very limited set of findings the interpretation of which is highly disputed and not shared by many researchers (see Friedman et al. 2003, Milligan et al. 2007, Perner and Horn 2003).

The most challenging scoffer attack: Do children at age 4 understand aspectuality?

But there is a third line of scoffer attack that is much more substantial and relevant for present purposes, since it rests on a more solid theoretical and empirical basis, and since, interestingly, it actually involves some of the key theoretical issues that will be important when dealing with booster attacks. The basic line of reasoning here is the

following: as has long been noted in the philosophy of mind, propositional attitudes essentially represent objects and states of affairs in propositional, fine-grained ways under some aspect or description and not under others (e.g. Anscombe 1957; Searle 1983). Believing that Superman lives next door is very different from believing that Clark Kent lives next door (the first will set you into motion when you are desperately looking for a superhero, but the second won't, for example)—even though both beliefs refer to the same object and state of affairs. Linguistically, the aspectuality of propositional attitudes is reflected in the intensionality of propositional attitude reports (e.g., McKay and Nelson 2014; Quine 1956; Searle 1983): In the context of propositional attitude reports[1] (E.g. "Peter beliefs that Clark Kent lives next door"), the substitution of co-referential terms ("Superman"/"Clark Kent") is not truth-value-preserving ("Peter beliefs that Superman lives next door" can be false even though "Peter beliefs that Clark Kent lives next door" is true). Crucially, aspectuality is not just an accidental or peripheral but an absolutely fundamental and essential property of beliefs and other propositional attitudes: there is no grasp of what propositional attitudes are without some basic grasp of their aspectuality.

Now, the scoffer attack in question doubts whether children around age 4 understand aspectuality, and thus whether they can be said to operate with propositional attitude concepts: On the one hand, standard FB and related tasks are consistently mastered around age 4—but they do not necessarily require an understanding of aspectualiy. In the most widely used change-of-location FB task, for example, the child has to track whether a protagonist has witnessed the transferal of an object, but does not have to take into account under which aspect or description the protagonist has witnessed this. On the other hand, the existing empirical evidence explicitly designed to tap children's understanding of aspectuality (and intensionality) suggests that such an understanding develops only long after age 4 (Apperly and Robinson 1998, 2002; Kamawar and Olson 1999, 2009, 2011; Russell 1987; Sprung et al. 2007). Taken together, these sets of findings thus put serious pressure on the orthodoxy.

But how serious is this pressure? In order to evaluate this question, let us take a closer methodological look at the existing empirical evidence. The first tasks in this area were direct linguistic tests of children's grasp of intensionality. Subjects were presented with premises of the form

(1) The protagonist is looking for the thief
(2) The thief is the man with the curly hair
(3) The protagonist does not know that (2)

and then asked directly "Can we say: 'The protagonist is looking for the man with the curly hair?"' [correct answer: no] (Russell 1987; Kamawar and Olson 1999).

Subsequent less exclusively verbal tasks presented children with action prediction measures along the following lines: Children witnessed a story with the following structure:

(4) There is an A (e.g. rubber) in box 1

[1] This is true, at least, on the *de dicto* (in contrast to the *de re*) reading of propositional attitude reports (Quine 1956).

(5) There is a B (e.g. dice) in box 2
(6) The B in box 2 is also an A
(7) The protagonist knows that (4) and (5), but does not know that (6)

and were then asked the test question: "The protagonist is looking for an A (rubber). Where will he go to find one?" [correct answer: box 1] (Apperly and Robinson 1998, 2002; Sprung et al. 2007).

Both of these two types of tasks were difficult for children up to age 6–8, and were much more difficult than standard FB tasks. Do they then show that 4-year-olds fail to understand aspectuality? Possibly, but not necessarily. The main reason is that these types of tasks arguably involve performance factors other than what they aim to measure (understanding aspectuality), linguistic demands in the first type of task, and other cognitive factors in the latter. In particular, these tasks involve ambiguity of referential expressions ("an A") and therefore the necessity for reference resolution (which A?)—which, as we know, even adults often find difficult (Keysar et al. 2003). So, in effect these findings may show children around age 4 consistently fail to understand aspectuality and thus cast doubt on the orthodoxy. Alternatively, however, these findings may show that children find some aspects of these particular tasks (such as understanding ambiguity and engaging in reference resolution) difficult.

In response to these concerns, in a recent set of studies we therefore developed tasks of understanding aspectualiy with radically reduced performance factors, modeling them in structure after standard FB tasks as closely as possible in order to construct a more stringent contrast pair of matched standard FB and aspectuality tasks.

The basis experimental logic is depicted in Fig. 1: There is an object that is both an A and a B that is put into box 1 in the presence of the protagonist under its A-aspect.[2] In the second step, the object is taken out of the box and transformed to reveal its other aspect (B) and put back into box 1 under this B-aspect. In the final step, visible to the protagonist, the object is moved, under its B-aspect, from box 1 to box 2. There were three conditions: in the crucial *"intensional" condition*, the protagonist is not present at step 2 and thus unaware that the A and the B are identical. Here the test question is where she will look for the [A]. In the *"extensional" condition*, she is also not present at step 2 and therefore unaware of the identity of A and B, but the test question is where she will look for the [B], and in the*true belief condition* she is aware of the identity and the test question is where she will look for the [A]. The results of three studies with tasks of this general logic (Rakoczy et al. 2015) were the following:

[2] Different types of objects with two aspects were used in different experiments of that study: (i) There were soft toys with two sides that could be turned inside out. For example, a soft toy bunny was introduced; then it was explained that the bunny was also a carrot, and the carrot-side was revealed by turning the soft toy inside out. (ii) There were toy figurines with two identities. For example, a figure called "Peter" was introduced; then in the second step it was explained that Peter was also the firefighter and his firefighter uniform was put on—so that perceptually he could then not be recognized as Peter anymore. In a slightly modified design, there were also (iii) dual function objects. For example, a pen was introduced in the first step; then it was shown—by rattling—that the pen was also a rattle. Then the object was transferred as "rattle" in such a way that one could hear it rattle but could not see it.

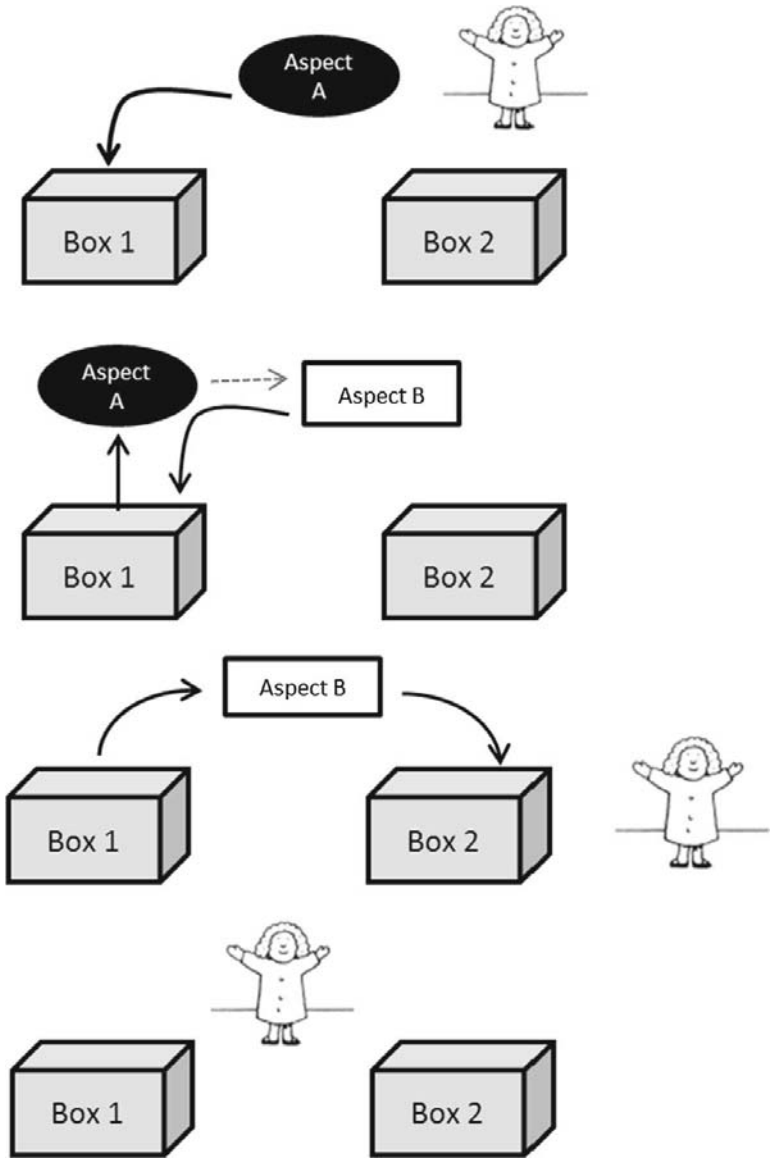


**Fig. 1** Basic experimental logic and setup of the new aspectuality task in Rakoczy et al. (in press)

- Children aged 4–6 were competent at solving the simplified task, answering "box 1" significantly more often than expected by chance in the crucial "intensional" condition (and "box 2" in the two control conditions).
- Children performed on these aspectuality tasks at the same level as on standard 1st order FB tasks.
- The two types of tasks were strongly correlated, even if age and verbal ability were controlled for.

What the findings in this new radically simplified task thus suggest is that previous negative findings in aspectuality tasks seem to have been due to extraneous performance factors (understanding ambiguity etc.) rather than the capacity to understand aspectuality per se. Once these performance factors are removed, aspectuality and standard FB tasks are equally difficulty and, as indicated in the correlations, seem to tap a common underlying cognitive capacity—most plausibly, the capacity to operate with the conceptual scheme of (essentially aspectual) propositional attitudes. The

aspectuality-centered scoffer attack can safely be rejected, and in the course of doing so the orthodoxy gets even more corroboration: Explicit ToM is an even more unified phenomenon than previously assumed.

### 2.2 Booster attacks

Much more widely discussed in recent debates, though, are the booster attacks with their central claim that the orthodoxy radically underestimates early ToM capacities. The empirical background are the spectacular new findings that even infants and toddlers seem to perform proficiently on a variety of ToM tasks once these are presented in non-explicit, non-verbal format (see Baillargeon et al. 2010, for an overview). When witnessing standard change-of-location FB scenarios, for example, children from age 1 indicate sensitivity to the protagonist's false belief in their looking time (Onishi and Baillargeon 2005), their anticipatory looking (Southgate et al. 2007), their neural responses (Southgate and Vernetti 2014) and in their spontaneous helping behavior (Buttelmann et al. 2009; Knudsen and Liszkowski 2012). Now, how are these findings to be reconciled with the huge body of evidence documenting failure in explicit change-of-location FB tasks before age 4? Three kinds of theoretical responses have been given to this tension:

First, skeptical responses, in defense of the orthodoxy, raise doubts whether the early non-explicit tasks—in contrast to the explicit ones—document any capacities to track mental states at all, and try to explain children's behaviour in these tasks in more parsimonious ways, for example as results of purely associative or statistical learning (Perner and Ruffman 2005).

Second, early competence accounts, mostly nativist in spirit, in their booster attack on the orthodoxy, consider the implicit tasks to tap the real core cognitive ToM competence, unclouded by performance factors in terms of linguistic and inhibition tasks demands. According to these accounts, it is such task demands that make explicit ToM tasks artificially difficult and therefore non-valid indicators of true ToM (Carruthers 2013; Leslie 2005): the orthodoxy is simply based on methodologically flawed tasks.

Third, however, conceptual expansion accounts, going beyond such simple dichotomies (is it the implicit tasks or the explicit ones that measures true ToM?) develop a more differentiated picture: the early implicit tasks do tap some form of mental state tracking, and these precocious capacities are perhaps precursors to the later developing conceptual capacities measured in explicit tasks, but they are not necessarily the same thing (e.g. Apperly and Butterfill 2009; Perner and Roessler 2012; Rakoczy 2012). There is not just improvement in extraneous factors (such as linguistic or inhibitory proficiency) that finally allow children to deal with task demands of explicit FB tasks between the ages of 1 and 4, but true conceptual development. Particularly promising variants of conceptual expansion views are recent 2-system-accounts (Apperly and Butterfill 2009; Butterfill and Apperly 2013). According to these accounts, the capacities tapped in implicit tasks are subserved by a simpler, evolutionarily and ontogenetically more ancient system (System 1) that operates fast and independently of central cognitive resources (such as language or executive function), but that has clear signature limits—enabling competence in some, but only a limited

variety of ToM tasks. In contrast, the capacities tapped in explicit tasks, are subserved by System 2, that develops later, dependent on language and executive function, and that operates with the conceptual apparatus of our fully-fledge propositional attitude folk psychology.

Who is right? The booster attackers, or one of the other two accounts that are explicitly in defense of (or at least more compatible with) the orthodoxy? Radically skeptical positions become less and less plausible given the wealth of convergent findings from various implicit task formats. But the empirical situation so far still remains inconclusive between nativist early competence and conceptual expansion, in particular 2-system-accounts. The main reason is that most existing evidence is based on tasks (implicit change-of-location and related FB tasks) that fall in the class of cases that cannot differentiate between the accounts since their predictions for such tasks converge: The nativist early competence account claims that infants have the concepts of belief and other propositional attitudes at their disposal, and bring them to bear in tasks with sufficiently reduced performance factors. The 2-systems-accounts claim that infants use system-1-processes that allow the tracking of some simple mental states. In particular, System 1 can track other agents' relational (non-aspectual) attitudes towards objects and situations such as perceptually encountering and registering situations (Butterfill and Apperly 2013). Registration, in particular, though falling short of being a fully-fledged, aspectual propositional attitude, is a belief-like relational attitude.[3] And the capacity to track such belief-like registration states, supported by System 1, enables infants to solve a limited variety of FB tasks, namely level-I perspective-taking tasks and change-of-location tasks (for more detail, see Butterfill and Apperly 2013). In the latter, a protagonist sees an object O disappearing in location L1, before the object is transferred in her absence to L2. Upon her return, where will the protagonist look for O? In explicit versions, this question is directly put to children. In implicit version, children's corresponding expectations are measured in their looking time, anticipatory looking or spontaneous helping behaviour. From the point of view of the 2-systems-account, in such a task the infant simply needs to keep track of the facts that the protagonist has registered that O is in L1 and is thus (since the infant has not witnessed the protagonist registering any subsequent situation to the contrary) guided by this registration and will look for O at L1.

What is needed to decide between the early competence and the conceptual expansion accounts, and thus to evaluate the booster attack, are cases in which early competence accounts predict success while conceptual expansion accounts predict failure. According to the 2-systems-accounts, System 1 underlying the early competence in implicit tasks, given its restricted conceptual repertoire, has characteristic signature limits: while it can track relational attitudes and thus master some implicit change-of-location FB tasks, this system reaches its limits when it comes to situations where a protagonist has a false belief that cannot be tracked as a merely relational attitude. And it is here where aspectuality comes back into view. Tasks where a protagonist

[3] Many conceptual change and 2-system-acccounts assume that there are simpler forms of tracking both proxies for belief proper and other cognitive propositional attitudes as well as of desires proper and other conative propositional attitudes. My focus here is on the former—but parallel arguments would apply to the latter.

has a false belief about the identity of an object, much like those tasks described in explicit format above, require the application of concepts of aspectual propositional attitudes. Since such tasks can only be solved if the subject takes into account under which aspect (e.g. A/B) a protagonist has had cognitive access to and thus holds beliefs about a given object, they are the perfect test case for the hypothesized signature limits.

What is thus needed are designs involving contrast pairs of implicit tasks structurally as analogous as possible but differing in the crucial respect whether they can be solved by tracking relational attitudes or require an understanding of aspectual propositional attitudes. Recent research has just begun to implement such designs.[4] Jason Low and colleagues (Happe et al. 2006; Low and Watts 2013) have found evidence for signature limits predicted by the 2-systems-account in children's and adults' anticipatory looking behavior in different types of implicit FB tasks: preschool-aged children and adults showed correct anticipatory looking in standard change-of-location FB tasks in which it did not matter in which ways the protagonist saw the target object, but failed to do so in more complex tasks in which the protagonist was mistaken about the identity of an object that appeared in different ways from different sides (but see (Csibra 2012; Jacob 2012, 2014) for critique).

And in our lab, we have implemented the very same contrast between FB tasks that do/do not require an understanding of aspectual belief that we previously used for explicit tasks (Rakoczy et al. 2015; see above) in implicit tasks with younger children (Fizke et al. submitted). In these studies, spontaneous helping behaviour was used as dependent measure. This measure was modeled after a study suggesting toddlers' competence in a change-of-location FB task (Buttelmann et al. 2009): In that study, the protagonist put an object (with a single identity) into box 1, which was then transferred to box 2, and then the protagonist upon her return tried to open box 1. In the FB condition, she had been absent during the change of location, and in the TB condition she had been present. In the TB condition more children helped the protagonist to open box 1 (as if reasoning: "she knows O is not in box 1 anymore, so she must be trying to open it for another reason") whereas in the FB condition more children helped her open box 2 (as if reasoning: "she is looking for O in box 1, but it is actually in box 2"). In our aspectuality task, 2-year-old children first saw the same kinds of events as in the explicit version in the Rakoczy et al. (2015) study (see Fig. 1), with the same crucial contrast between TB (protagonist was aware of dual identity A = B) and FB (protagonist was not aware of the dual identity). Then the protagonist tried to open box 1, and children's spontaneous helping behaviour was recorded.[5] Performance on this novel aspectuality task was compared to a modified change-of-location tasks after Buttelmann et al. (2009) that, however, was kept as analogous as

[4] One study predating these recent designs might be taken to directly investigate infants' ascription of belief about objects' identities (Scott and Baillargeon 2009), but leaves it very unclear whether it really does so [for details, see Butterfill and Apperly (2013)].

[5] It is important to note that we know from previous work with such kind of stimuli that children at this age (in fact, children from age 1) do understand that the two aspects pertain to the same object and that the transformation from one aspect to the other is reversible (Cacchione et al. 2013). And children were familiarized with the transformations themselves in an introductory phase of the experiment so that they could have (and sometimes, but only rarely, did so) taken the object and transformed it back for the protagonist if in fact they were unsure whether she would like it under the second aspect.

possible to the aspectuality task in terms of working memory and other task demands. The results revealed that in the change of location conditions, 2-year-olds helped the protagonist to search the object in box 2 significantly more often in the FB than in the TB condition—indicating that they did track the protagonist's belief-like state in some ways (replicating Buttelmann et al. 2009). In contrast, in the identity condition, children did not behave differently in the FB and TB conditions (mostly helping the protagonist to open box 1).

This study thus suggests that there are signature limits in early implicit ToM along the lines predicted by one conceptual expansion theory, the 2-systems-account. In fact, taken together with the results of the explicit aspectuality study reported above, the results present an even more comprehensive and stringent argument against the booster attack, and for conceptual expansion accounts (and thus for the orthodoxy): the dissociation of competence in different types of implicit FB tasks in 2-year-olds suggests what is at work early on is not yet the fully-fledged conceptual apparatus of propositional attitude psychology. But the strong unity—both in terms of absolute performance levels and in terms of intra-individual correlations—between different types of explicit FB tasks strongly suggests a common underlying cognitive apparatus at age 4: the fully-fledged conceptual scheme of aspectual propositional attitudes.

## 3 The emerging picture

The orthodoxy that children operate with fully-fledged propositional attitude concepts such as belief from around age 4 thus seems to survive both scoffer and booster attacks well. And what comes out of the defense against these attacks as the most plausible version of the orthodoxy is one that is qualified by recent conceptual expansion accounts: yes, fully-fledge folk psychological concepts are in operation from around age 4. But that does not mean that before this there is no tracking of others' mental states at all. Rather, there are simpler forms of tracking mental states—for example, in terms of relational (non-aspectual) attitudes such as encountering, registration and the like that are in place much earlier according to the 2-systems-account. Such accounts take seriously but neutralize the scoffer-arguments, in particular concerning aspectuality: they accept the scoffer attack's premise (if children do not understand aspectuality then they cannot be credited with a propositional attitudes folk psychology) but show that the antecedent is simply not fulfilled when tested properly. And such accounts give the intuitions behind the booster attacks their due: there is certainly more to infant social cognition than mere behavior-reading. But they show that more than behavior-reading can still be much less than full-fledged folk psychology: the middle ground is populated by forms of tracking relational mental states in conceptually much less sophisticated ways than propositional attitude psychology.

## 4 The future of social cognition: questions, questions, questions

There is a fair chance, in my opinion, that the future of social cognition research—to take up the title of this issue- belongs to the further development of such differentiated conceptual expansion theories, in particular in form of two-systems-accounts. Given

the novelty of applying the framework of dual-system-theories to theory of mind research (beginning, basically, with the very recent seminal paper by Apperly and Butterfill 2009), many fundamental and exciting questions currently in the air will set the agenda in future debates.

### 4.1 The relation of 2-systems-accounts and nativist early competence theories

First of all, what exactly is the relation of two-systems-approaches to other accounts that do or do not subscribe to the orthodoxy? Concerning the relation to the most important orthodoxy-opponents, nativist early competence accounts, a very fundamental challenge is to get a clear grip on which disputes are merely terminological and which are substantial. The reason is that in the background there are widely diverging criteria in play of what it takes to possess a concept, have a competence etc. Many nativist accounts operate with rather minimalist, atomistic notions of "concept" and "competence" (e.g. Leslie 2000, 2005) according to which concepts can be in place even if its user cannot use it in inferentially flexible way, and according to which there can be a cognitive competence that is so severely masked by performance factors that it does not show up in the rational control of action but merely in looking behavior. This is in stark contrast to much thicker notions of the same concepts used in other accounts, including 2-systems-approaches according to which concepts are (at least partly) individuated by their inferential liaisons and their role in reasoning and other rational activities (see Butterfill and Apperly 2013; Rakoczy 2012). Systematic conceptual clarification will thus be needed to reveal which of the disputes between nativists claiming "infants have a concept of belief" or "infants have the competence to represent beliefs" and other researchers disagreeing turn out to be largely verbal since what the former consider to be a conceptual competence masked by performance factors would not be considered conceptual at all nor a proper competence by the latter. Even though it might then turn out that many or even most of the disputes are largely terminological in this sense, such clarification will help to sharpen the focus on those issues that clearly are substantial. And the signature limits concerning early understanding of aspectuality investigated here are such an issue—perhaps even the most central one—with diverging and testable empirical predictions.

### 4.2 The relation of 2-systems-accounts and more traditional conceptual expansion accounts

Concerning the relation to more traditional accounts subscribing to the orthodoxy, the fundamental question is to which degree 2-system-approaches are compatible with such accounts. Conceptual change theories of various guises, including the theory theory, have long been assuming that there are two (or more) levels of growing complexity in children's developing theory of mind, the second of which operates with fully-fledged representations of mental representations, in particular propositional attitudes, whereas the first is confined to less sophisticated representations of non-aspectual cognitive relations such as non-epistemic perception, cognitive acquaintance and the like. For example, such two levels are assumed in Flavell's (1988) distinction

between understanding of "cognitive connections" versus "mental representations", Perner's (1988, 1991) "situation theory" versus "representation theory", and Gergely and Csibra's (2003) "intentional stance" versus "mentalistic stance" account.

There are some crucial respects in which 2-systems-accounts and traditional conceptual change accounts—though broadly compatible in converging on the orthodoxy—diverge in their claims and ontological commitments. Most importantly, conceptual change accounts, in particular the theory theory (TT), inspired by the historical analogies of scientific revolutions and paradigm shifts, assume that cognitive development is characterized by the successive revision of concepts (Gopnik and Wellman 1994). In line with the scientific revolution analogy, the new concepts are thought to replace the old ones, and, in fact, often to be incommensurable with them. Think of the historical and ontogenetic movement from geo- to heliocentric conceptions of planetary movement (Vosniadou 1994). This is the reason why in this paper I have been using the more neutral term "conceptual expansion" rather than conceptual change for the class of accounts that assume conceptual development such that ToM concepts (like "belief") come into play in the course of the first few life of years that were not there before. "Conceptual expansion" leaves open the possibility that new concepts supplement rather than replace old concepts or pre-conceptual abilities. And the 2-systems-theory clearly assumes such cumulative conceptual expansion without replacement whereas many TT account assume conceptual replacement. According to the 2-systems-account, System 1 predates System 2 evolutionarily and ontogenetically, but once System 2 has developed, it does not take over the place of System 1, but rather the two co-exist peacefully over the lifespan.

This emphasis on cumulative conceptual expansion and subsequent co-existence of different (pre-)conceptual processes certainly sets apart the 2-systems account from many more traditional conceptual expansion, in particular TT accounts. Most of the latter are purely developmental, assume conceptual replacement and do not make any claims about adults. But some of the more traditional accounts have been making similar assumptions of expansion and co-existence of different conceptual and explanatory schemes. Perner (1991), for example, has argued that children around 4 acquire a new conceptual framework for representing subjectivity, a representational theory of mind. Before that, they merely operate with a less sophisticated framework (situation theory) that allows the ascription of simpler mental states such as non-epistemic perception, teleological explanation of action by desires understood as relations to objective values ("he bought the lollypop because he wanted to have it" would be understood as "the bought the lollypop because having the lollypop would be good for him") etc. Rather than being replaced by the more complex conceptual framework, though, the more basic situation theory remains in place and being used by adults in many circumstances. The idea here is that adults are what could be called parsimonious mentalizers and operate with the less complex framework (situation theory) as long as it and to the degree that it works (illustrated nicely by the following anecdote: as a Bavarian, Franconian or Austrian beer drinker you see someone else take a sip of a fresh local beer—and then look disgusted. "What's wrong with the beer?" is your first impulse. Only after tasting and realizing that the beer is perfectly normal, it occurs to you that this person might come from a wine-drinking region or have deviant subjective taste for some other reason…).

So, are 2-systems-accounts important and innovative, yet basically friendly amendments to such more traditional accounts after all? Or are they (partly incompatible) alternatives in the sense that they involve ontological commitments –to there being distinct systems- that go beyond the general assumption of cumulative conceptual complexity common to conceptual expansion accounts?

The answer to this question will depend very much on the answers to a set of general questions concerning the status and inter-relations of the two (or more?) "systems". How ontologically laden is the notion of "system" in play here: are systems supposed to correspond to (anatomically or physiologically) identifiable substrates, or is the notion much less committal, referring basically to different kinds of processes? While 2-systems-account of ToM clearly seem not committed to something as strong as systems in the sense of substrates, they do make one assumption that seems to set them apart from more traditional conceptual expansion accounts: There are not only conceptually more sophisticated cognitive processes and less sophisticated forms of conceptual or proto-conceptual capacities; but the two are based on qualitatively different kinds of processes, the former on deliberative, effortful conscious ones (the usual supects of properties associated with System 2 cognition), the latter on fast, automatic and efficient ones (the usual suspects of properties associated with System 1 cognition). This assumption leads straightforwardly to very interesting and distinctive empirical predictions: developmentally, children under age 4 should show some precocious capacities to solve some FB tasks, but only of such format as to not address (deliberative, effortful etc.) System 2 processes. Concerning adults, they should exhibit automatic ToM processes with the characteristic signature limits under conditions of covert and spontaneous tasks (without any instruction to engage in ToM reasoning whatsoever) and under conditions of cognitive load (e.g. dual task scenarios).

Theoretically, it is not clear whether these predictions are necessarily unique to the 2-systems-account and set it apart from other conceptual expansion accounts: Could such differences in processes not themselves be explained by conceptual expansion accounts through reference to the different (proto-)conceptual sophistication at the different levels of functioning (for such attempts in terms of varying degrees of explicitness of the underlying representations see, e.g. (Dienes and Perner 1999, 2003); for an attempt in terms of varying relational complexity of the underlying representations, see (Halford and Andrews 2014)? Empirically, there are two sets of questions raised in this context that are currently hotly debated: First, are precocious infant ToM capacities really restricted to task formats tapping mere looking behaviour—arguably good indicators of utterly implicit and automatic processes- or do children before age 4 reveal their nascent ToM capacities in behaviours more rationally guided and integrated such active anticipatory helping (Rhodes and Brandone 2014) or even spontaneous verbal behaviour (Rubio-Fernández and Geurts 2013)? Second, is there such a thing as automatic perspective-taking in adults? While a number of spectacular studies in the last five years have suggested that adults automatically track others' (level I) perspective even if not asked to do so and without being aware of doing so (Kovács et al. 2010; Samson et al. 2010; van der Wel et al. 2014), very recent work has put into question whether these findings really reveal automatic perspective-taking, or rather simpler cognitive processes (Phillips et al. in press; Santiesteban et al. 2014).

In conclusion, both theoretically and empirically, it remains open for future clarification whether the levels of ToM of varying complexity—agreed upon by the 2-systems-account and other conceptual expansion accounts- map onto the use of different conceptual schemes and processes, not necessarily fundamentally different in kind (consistent with more traditional conceptual expansion accounts), or onto distinct systems fundamentally different in kind.

### 4.3 What are the relations between the "systems"?

A final, related issue for future clarification concerns the relations of the hypothesized two systems to each other: Are they supposed to be totally independent from each other, as some writings of 2-systems-proponents might be taken to suggest, and thus doubly dissociable? That is, would it not only be possible to find System 1 in the absence of System 2 (the unproblematic case), but the reverse dissociation (System 2 in the absence of System 1) as well? Empirically, one set of recent findings might be taken to speak for such an option: adults with Asperger Syndrome mastering explicit ToM tasks did not show the spontaneous anticipatory looking in such tasks that neurotypical infants and adults typically show (Schneider et al. 2013; Senju et al. 2009). But the nature and implications of this finding currently remain highly unclear, leaving open many fundamental issues (Is it actually the same System 2 capacity seen in Asperger patients and neurotypical adults, or have the subjects with Asperger syndrome laboriously acquired an alternative solution to ToM problems? Even if the same System 2 capacities are in play, can they be achieved ontogenetically via different routes, the typical route going via System 1?).

Probably the generally more plausible reading is that the two are not totally separate and thus doubly dissociable, but that System 2 builds on System 1 in one way or another. One form of such one-way dependency relation would be developmental, as some recent combinations of core knowledge and conceptual change accounts assume (Carey 2009; Spelke 2003): System 1 would be a developmental prerequisite, precursor or foundation of System 2. This picture would fit with the analogy to numerical cognition that Apperly and Butterfill (2009) frequently make use of when introducing their 2-systems-conception: In numerical cognition, we know of two core systems[6] for discrimination set sizes (the object file system for the exact representation of small sets, and an analogue magnitude system for the approximate estimation or arbitrarily large set sizes) that are evolutionarily old, widespread in many species in the primate lineage and beyond, present early in ontogeny and that remain intact over the lifespan (Feigenson et al. 2004). These two systems each have characteristic scopes but clear signature limits: the object file system tracks exact set sizes, but works only for small sets in the subitizing range (<4 or 5), the analogue magnitude system tracks sizes of arbitrarily large sizes, but only works approximately. Given these limitations, they clearly cannot be said to involve representations of number in the conceptual sense.

[6] In fact, whether there are two distinction systems or just one, is a matter of considerable dispute (see e.g., Gallistel (1990).

But they,[7] together with the acquisition of the corresponding linguistic representations (number words, count routines) lay the ontogenetic foundation for the acquisition of a fully-fledged conceptual scheme of number (Carey 2009). By analogy, in the case of theory of mind, the more foundational System 1 capacities present in infants have clear scope—they allow tracking relational attitudes—with clear corresponding signature limits: they fall short of representing propositional attitudes in the proper conceptual sense, since they do not allow for representing aspectuality (and potentially other essential properties of propositional attitudes such as belief's normative relation to truth etc.).

Another, perhaps complementary form of such a one-way dependency relation between System 1 and System 2 cognition would be not exclusively in terms of development over time, but in terms of processes involved at a given time: System 2 processes presuppose or build on System 1 processes. There are at least two ways in which this could be the case, corresponding to two widespread interpretations of the logical structure of 2-systems-accounts. The difference between the two systems could be understood along the lines of the modular-central distinction (Fodor 1983): System 1 processes are modular, and deliver their output as input to central System 2 cognition. Here, System 2 would depend in the informational sense on System 1 in the way the President depends on his consultants: not much thinking in the former without the information coming in from the latter.

Or the difference between the two systems could be understood such that System 1 processes are sub-personal in contrast to the personal level System 2 processes, and that the latter are realized (partly) in the former (e.g. Frankish 2009; Rakoczy 2012). On such a picture, the subpersonal, subdoxastic and non-conceptual System 1 processes would, once suitably functionally integrated with other subpersonal processes (underlying executive function, language etc.) so that inferential integration, flexible and general ascription of propositional attitudes contents etc. become possible, constitute the realization base of the personal level, conceptual System 2 capacities. Here, System 2 would depend on System 1 in the constitutive sense in the way that the functioning of the State depends on the functioning of the Parliament: the State's functioning (for a certain kind of State) is partly realized in or constituted by the Parliament's functioning. Such a picture, understood in broadly functionalist terms, could do justice both to the conceptual continuity intuitions of early competence nativist accounts and to the true conceptual development intuitions of conceptual expansion accounts: There are sub-personal processes underlying precocious ToM that are present early on and continue to function over the lifespan. These are (among) the core realizers of fully-fledged conceptual personal-level folk psychological ascriptions of propositional attitudes. That the subpersonal processes S1 processes are (among) the core realizers (rather than the total realizers) means that by themselves they do not yet realize the S2 processes. They do so only once, over development, they get integrated, coordinated and hooked up with other subpersonal processes in the right and systematic way (to enable the rational integration, flexibility, systematicity etc. essential of the personal level)—where then the suitably related subpersonal processed together constitute the

[7] Or at least one of them—there is a controversy about this question related to the controversy mentioned above see Carey (2009).

total realizer of the corresponding personal level capacity (Frankish 2009; Shoemaker 1981).

## 5 Conclusion

All in all, the aim of the present paper was to argue that there are good empirical reasons to defend the orthodox claim in developmental ToM research that children begin to operate with "belief" and other propositional attitude concepts from around age 4 against attacks from boosters and scoffers. In contrast to scoffers' concerns, the conceptual scheme that emerges at this age is even more coherent and unified than previously assumed—it truly is the scheme of propositional attitude folk psychology. And in contrast to scoffer doubts, this scheme is something qualitatively different from the earlier precocious capacities found in infants. The most promising way to work this all out will probably be some kind of a 2-systems-theory along the lines of the account recently put forward by Apperly and Butterfill (2009). Spelling out such a bigger picture in more detail in light of all the open questions mentioned above, will be one of the most exciting and promising projects in the future field of social cognition research.

**Acknowledgments** I would like to thank Steve Butterfill for very helpful comments and discussion. Thank you very much to Alexander Dieball for help with the references.

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