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Do children understand desires before they understand beliefs? A comparison of 3-year-olds' grasp of incompatible desires, competitive games and false beliefs

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ABSTRACT

A long-standing dispute in theory of mind research concerns the development of understanding different kinds of propositional attitudes. The asymmetry view suggests that children understand conative attitudes (e.g., desires) before they understand cognitive attitudes (e.g., beliefs). The symmetry view suggests that notions of cognitive and conative attitudes develop simultaneously. Relevant studies to date have produced inconsistent results, yet with different methods and dependent measures. To test between the two accounts more systematically, we thus combined different forms of desire tasks (incompatible desires and competition) with different forms of measurement (verbal ascription and active choice) in a single design. Additionally, children's performance in the desire tasks was compared to their false-belief understanding. Results revealed that 3-year-olds were better at ascribing desires than at ascribing beliefs for both desire tasks whereas they had difficulties actively choosing the more desired option in the competition task. The present findings thus favor the asymmetry theory.

1. Introduction

In everyday life we explain each other's rational actions by ascribing two kinds of propositional attitudes: conative attitudes like desires and preferences pertaining to how the world, from the agent's subjective perspective, ought to be; and cognitive attitudes like beliefs pertaining to how the world, from the agent's subjective perspective, is (Davidson, 1963). "Why is he making these painful exercise that make him look so ridiculous?" – "Because he wants to stay young and believes these exercises are a good means to do so". Since the combination of conative and cognitive attitudes constitute the subjective reasons for actions with recourse to which we explain and justify each other's behavior, our folk psychology is also often referred to as "belief-desire psychology" (Fodor, 1975; Wellman, 2010).

From the point of view of conceptual development, a basic question of theory of mind research is how the grasp of these two kinds of propositional attitudes emerges in ontogeny. In a long-standing debate, two (prima facie) opposing views have been put forward and contrasted: According to the *asymmetry view*, children acquire an understanding of conative propositional attitudes such as desires before an understanding of cognitive propositional attitudes, beliefs in particular (e.g., Rakoczy, Warneken, & Tomasello, 2007; Steglich-Petersen & Michael, 2015; Wellman, 1990). This asymmetry may be due to various (not mutually exclusive) factors: first, desires seem to have a simpler logical structure than beliefs: Beliefs have mind-to-world direction-of-fit – their job being, so to speak, to

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represent the world as it is (Searle, 1983). There is thus a normative standard of truth to which beliefs adhere, and ascribing beliefs, false ones in particular, requires an awareness of and potential deviation from this default. Such deviation from the standard, in turn, may be demanding in terms of inhibition and related executive functions (Rakoczy, 2010; Sabbagh, Moses, & Shiverick, 2006). Second, children may have had more experience with the coordination of desires compared to the coordination of beliefs (Rakoczy et al., 2007). Third, the developmental asymmetry may be due to differences in the ways the two kinds of attitudes figure in explanations. In everyday action explanations, desires usually play a much clearer and more prominent role than beliefs. When asked "Why is he making these painful exercise that make him look so ridiculous?", a common and natural response would be to simply omit the cognitive premise and just explain the action by the desire "Because he wants to stay young" (this explanatory strategy works perfectly as long as the agent is not mistaken, Steglich-Petersen & Michael, 2015).

In contrast, the *symmetry view* assumes that children develop a fully-fledged understanding of subjective propositional attitudes, both conative and cognitive ones, simultaneously around the age of four (Perner & Roessler, 2010; Perner, Zauner, & Sprung, 2005). Around this age children acquire a more general conceptual (meta-representational) framework that enables them to grasp truly subjective perspectives. Before this crucial developmental step, young children operate with more basic concepts that are precursors to fully-fledged propositional attitude concepts. In the case of cognitive attitudes, precursors to the fully-fledged concept of belief are concepts such as perceptual access or having (vs. lacking) information more generally. Young children can thus understand that e.g., one agent has witnessed some event whereas another one has not or can understand level-1-perspective-taking problems (the very same object is seen by one person, but not by another). What this young child cannot yet understand is that two people may hold conflicting, potentially false beliefs about the same situation, or see the same object in different ways (level-2 perspective-taking). In the case of conative propositional attitudes, precursors to the fully-fledged concept of subjective desires center on objective goals and desirability. Young children can understand, in teleological manner, that agents pursue goals (conceptualized as future states of affairs to which they are drawn), and that certain states of affairs are desirable or good for certain agents. On the basis of such precursor concepts, young children's reasoning can appear remarkably sophisticated: from age 2–3 or even earlier, children use desires (conceptualized as desirability) to explain and predict actions (Bartsch & Wellman, 1995; Wellman & Woolley, 1990) and to ascribe desire-dependent emotions accordingly (Hadwin & Perner, 1991; Wellman & Banerjee, 1991). They can even understand that different agents may have different preferences (see Repacholi & Gopnik, 1997). But there are clear conceptual limits to what young children can grasp with this conative precursor framework. In particular, on the basis of the notion of objective desirability alone, one cannot understand cases in which a person's desire conflicts with what is (objectively) desirable (from the interpreter's point of view); and one cannot understand cases in which two agents' desires are in conflict and thus incompatible with each other (Perner & Roessler, 2010). What is required to grasp these two kinds of cases is a truly subjective notion of desire such that the content of what is desired can conflict with objective values, and can conflict with the content of other desires (either by the same person, or by someone else). And it is this subjective notion of desires that, according to the symmetry view, develops in tandem with the corresponding subjective notion of belief around age 4.

Crucial test cases between the asymmetry and the symmetry account are thus those in which children are asked to ascribe a desire to an agent that is incompatible either with objective desirability or with another agent's desires. The empirical picture that emerges from studies on these test cases, so far, is somewhat complex and partly inconsistent. First, work on children's understanding of "wicked desires" (those in conflict with objective moral values) has only investigated children's ascription of desire-dependent emotions without any comparison to false belief understanding (Smith & Warneken, 2014; Yuill, Perner, Pearson, Peerbhoy, & van den Ende, 1996). It is thus impossible to draw firm conclusions concerning the competing accounts.

Second, concerning children's understanding of two agents' incompatible desires, mainly two lines of research have been conducted that differ in both their operationalizations and results. Initially in the debate, the critical test cases for understanding incompatible desires agreed upon were tasks in which children had to understand that two agents held desires that were incompatible in the following sense: the propositional contents of the two desires could not both be fulfilled at the same time. Imagine, for example, a situation in which two agents A and B, who are sitting in a boat together, reach a river junction where A wants the boat to go left and B wants it to go right (Lichtermann, 1991). Their desires are incompatible since their contents ("boat goes left now" vs. "boat goes right now", respectively) cannot both be fulfilled. Formally speaking in terms of payoff matrices, these situations thus have an underlying (1;0) vs. (0;1) payoff-structure for players A and B, respectively[1] : Either A can get what she wants (boat left), but B does not (1;0), or vice versa (0;1). Several studies have implemented such scenarios. Children were asked about the diverging desires of the two agents, respectively, as well as about their desire-dependent emotions after one of the events happened (the boat going left or right). Results revealed that three-year-olds successfully ascribed desires and emotions, even though they mostly failed standard false belief tasks (see Fizke, Barthel, Peters, & Rakoczy, 2014; Rakoczy, 2010; Rakoczy et al., 2007). These findings speak in favor of the asymmetry claim.

Whether such incompatible desires scenarios are indeed crucial cases to test and decide between symmetry and asymmetry accounts, however, has recently come under dispute (Perner & Roessler, 2010; Priewasser et al., 2013; Roessler & Perner, 2013). Priewasser et al. (2013) argue that the (1;0) vs. (0;1) payoff-structure might in fact be solved by children without any need to really consider both subjective desires. Rather, children may master such tasks by focusing on only one perspective at a time. Competence in this task would thus not necessarily indicate an understanding of truly subjective perspectives. A more stringent test case would require the child to *simultaneously* consider both person A's and person B's desire. This is the case only if an understanding of one desire strictly requires taking into account the other one. And this, in turn, is only the case if the one desire is contingent upon the other. These

[1] In this standard payoff notation, the first/second numbers in brackets indicate the payoff for players A/B, respectively. That is, in a (1;0) case, A receives 1 unit of reward and B receives nothing.

requirements are fulfilled by the more complex (1;0) vs. (1;1) payoff-structure typical of interdependent competition in games: person A always gets the same individual payoff. Considered in isolation, the two options are thus equally attractive for A. However, what differs between options is the payoff for the other player B (in the first option she gets nothing (1;0), whereas in the second option she gets the same payoff as A (1;1)). In competitive games in which the aims are relative (to be better than the competitors), thus, the first option is what a rational player A desires in light of B's desires.

In the first study to stringently test children's understanding of such more complex payoff-structures, Priewasser et al. (2013) compared children's active performance in a competitive game with their ability to ascribe false beliefs. Children in triads played a game in which that child won whose stand was first entirely filled with beads. Importantly, the beads for the own stand could be obtained by either taking them from a community pot (neutral move) or by taking them from another player's stand (poaching move). Thus, independent of which option child A chose she received one bead, but what differed between the options was whether the other child B kept all of her beads (neutral move (1;0)) or lost one of her beads (as it was taken away by child A, poaching move (1;-1)). Results revealed that the children who produced poaching moves tended to be those that were able solve false belief tasks – as predicted by the symmetry view.

Taken together, thus, the two lines of research on children's understanding of incompatible desires and on their understanding of competition seem to conflict with each other. The former speak in favor of the asymmetry, the latter in favor of the symmetry view. How can these diverging findings potentially be reconciled? First of all, from a theoretical point of view, it remains to be disputed whether the more complex payoff-structures typical of competition are really the suitable litmus test, as argued by the most recent version of the symmetry account. But even if one provisionally accepts this premise for the sake of the argument, it remains unclear from an empirical point of view why the different tasks produced such different results. From existing findings, this is difficult to tell since the tasks differed on a number of dimensions in addition to the payoff-structures. One potentially relevant difference pertains to the way children could indicate their desire understanding. In the task used by Rakoczy et al. (2007), children were asked to explicitly ascribe desires and desire-dependent emotions to the agent whereas Priewasser et al. (2013) measured the child's own active poaching moves. The differences in findings might thus reflect merely differences in performance (rather than competence): children may have been able to ascribe subjective and mutually incompatible desires in both tasks, but may have been hesitant (e.g., for reasons of politeness) to use this understanding to strategically poach other players.

In light of these open questions and possibilities, the rationale of the present study was to test between the symmetry and asymmetry accounts in more systematic and stringent ways. To this end, we designed tasks that tapped children's understanding of two players' incompatible desires and systematically varied payoff-structures as well as the modes of indicating desire understanding. Three-year-olds played a game against a hand puppet in which the first to cross a finish line was the winner and received a desired prize. In each round, the players could move one field ahead towards the finish line. Between participants, we varied the underlying payoff-structure by determining possible moves. In the incompatible desires condition, the two possible moves resembled a (1;0) vs. (0;1) payoff-structure: in each round either the child or the puppet was allowed to move. In the competition condition the two options resembled a (1;0) vs. (1;1) payoff: either only the child or both the child and the puppet were allowed to move. The other crucial manipulation was the mode of indicating desire understanding: In half of the trials, the outcome of a chance device (a wheel of fortune) determined who was allowed to move in each round (i.e., (1;0) vs. (0;1) in the incompatible desires and (1;0) vs. (1;1) in the competition cases, respectively). In these trials, children were asked about the two players' desires, and their desire-dependent emotions (as in Rakoczy et al., 2007). In the other half of the trials, children could actively determine the outcome of the wheel of fortune, and thus their active choices were the target dependent measures (similar to the poaching moves in Priewasser et al., 2013). In addition, children's false belief understanding was assessed.

The following patterns of results would be particularly informative since they would constitute evidence in line with the asymmetry account: (a) Three-year-olds perform competently for desire ascriptions in both incompatible desires and competition contexts. (b) They do so even if they fail false belief tasks. (c) This competence is moderated by task complexity: emotion ascription may be more difficult than mere desire ascription (see Harris, Johnson, Hutton, Andrews, & Cooke, 1989); and competition may be more difficult than incompatible desires. (d) The mode of indicating desire understanding makes a crucial difference: children might not show their desire understanding in their active choices in the competition condition to the same degree as they do in direct desire ascription because, plausibly, competitive moves are influenced by many additional factors such as (overcoming) politeness, shyness, etc.

2. Methods

2.1. Participants

Eighty-eight 3-year-old children were tested. The sample size was set a priori, following previous studies in this area. Seven of these children had to be excluded from analyses because they did not pass the warm-up (see below). Thus, the final sample consisted of 81 3-year-olds (range 36–47 months, $M = 40.63$ months, 46 girls). All children were from mixed socio-economic backgrounds and were recruited from a local database of parents who had previously given consent to participate in developmental studies. Twelve additional children started the testing session but did not finish the procedure because of language difficulties ($N = 2$), uncooperativeness ($N = 7$) or experimental errors ($N = 3$). Dropouts were equally distributed in the two conditions.

2.2. Design and procedure

The study followed a 2 (condition: incompatible desires or competition) x 2 (mode of indicating desire understanding: explicit

questions or active choice) mixed design with condition as between-subjects factor and mode of indication as a within-subjects factor. Children were randomly assigned to the incompatible desires or competition condition, with the two conditions only varying in the underlying payoff-structure of the desires task: In the incompatible desires condition the payoff-structure was (1;0) vs. (0;1) while in the competition condition it was (1;0) vs. (1;1). Each child was tested in a single session (~25 min) in which she received a change-of-location false belief task and the respective desires task in counterbalanced order.

2.3. Materials

2.3.1. False belief task

Two traditional change-of-location false belief tasks (Wimmer & Perner, 1983) were administered by acting out the story with little plastic figures. In the first task, a boy put a die in a red box. In his absence, a girl moved the die into a blue box. Children were then asked three control questions "Where did the boy put the die first?", "Where is it now?" followed by "Who put it there?". Finally, children were asked the critical test question: "When the boy returns, where we will he look for the die?". The second story followed the same structure, with a man putting his car in one of two new boxes from where it was transferred in his absence.

2.3.2. Desires task

The overarching theme of the desires task was a sticker collection game which the child played against a hand puppet "Sticky". Sticky was introduced as a friendly monster who loves to eat stickers and would eat all the stickers he wins. The child was given a sticker album for her stickers to put in. The general set up for the game can be seen in Fig. 1. It consisted of a wooden spinning wheel with an arrow that could secretly be operated by the experimenter (E). Whenever the wheel was spun E accompanied the process with very ostensive exclamations such as "Let's see where it stops this time!" and many "ohs" and "ahs" to highlight the chance character of the outcome. After spinning the wheel, the arrow would point to either the right or the left side. On each of these two sides a tray with two bowls, one for Sticky and one for the child, as indicated by pictures, was placed. Throughout the game these bowls contained the rewards that could be obtained. The arrow indicated the side from which the rewards would be retrieved in that round.

2.3.2.1. Warm-up trials. The four warm-up trials served as an introduction to the general setup and the respective payoff-structures. Before each trial E placed simple stickers in the respective bowls according to conditions. In the *incompatible desires* condition on each tray only one sticker was placed in either the child's or Sticky's bowl. For instance, on the left tray only the child's bowl contained a sticker while on the right tray only Sticky's bowl contained a sticker (resembling a payoff (1;0) vs. (0;1)). In the *competition* condition on one tray only the child's or Sticky's bowl contained a sticker while on the other tray always both bowls contained a sticker (resembling the payoff (1;0) vs. (1;1)). In each trial E explained, bowl by bowl, whether the child and Sticky would receive stickers in dependence of the side the arrow would point to. The child was asked to repeat where the two players would or would not receive a sticker. Seven children were excluded from the final sample because they failed to correctly indicate the respective payoff-structures in

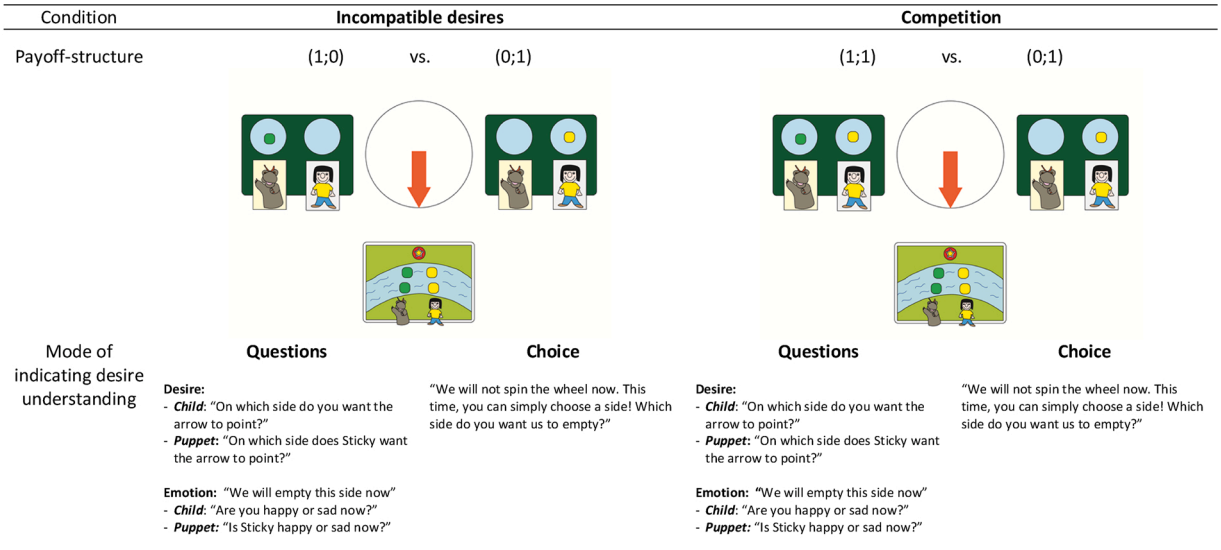

Fig. 1. General design of the desires task in the experimental trials for the incompatible desires and the competition condition. *Note.* In the middle of the set up one can see the wheel of fortune with the orange arrow. On each side of the wheel a tray with two bowls, one for the hand puppet Sticky and one for the child, were placed. In the incompatible desires condition only one bowl per tray contained a reward (here (1;0) vs. (0;1)) and in the competition condition one tray contained two rewards (one for the puppet and one for the child) and the other tray contained only one reward (for the child, here (1;1) vs. (0;1)). Below the wheel the board was placed with the two pawns on one side and the sicker on the other side of the river as well as the marked squares on the river where the obtained blocks were to be put.

in three or all warm-up trials. E then spun the wheel and secretly stopped it at one of the trays. Depending on the content of the bowls the players received their stickers.

2.3.2.2. Experimental trials. For the experimental trials, a board on which a river was painted was introduced. Both Sticky and the child received little pawns that were put on one side of the river. A cool, glittering sticker was placed on the other side of the river. Whoever crossed the river first, would receive the valuable sticker. To get to the other side, each player would need two wooden blocks as stepping stones. Hence, instead of the stickers themselves (as in the warm-up) in the experimental trials the wooden blocks were put into the bowls of the apparatus. Aside from that the general structure and importantly the payoff in the two conditions of the game remained the same. All children received four experimental trials, each consisting of a first critical round in which both players were still two steps away from the sticker and a second round where the sticker was actually won by one of the players. The different indicators for desire understanding (desire and emotion questions, choice/action) were only administered in the first of these two rounds.

2.3.2.3. Desire and emotion questions. In two of the four experimental trials, E first placed the blocks into the respective bowls (implementing the (1;0) vs. (0;1) or (1;0) vs. (1;1) structure). She then asked the child the two *desire questions*:

(a) Desire child: "On which side do you want the arrow to point?"
(b) Desire puppet: "On which side does Sticky want the arrow to point?"

After that the wheel was spun and stopped at one of the two sides (in alternating order for the two trials), thus revealing who would be allowed to move a step towards the sticker (either the child or Sticky in the incompatible desires condition or either the child or both in the competition condition). The child was shown a sheet with a smiling and a frowning face and asked the two *desire-dependent-emotion questions*:

(a) Emotion child: "We will empty this side now. Are you happy or sad now?"
(b) Emotion puppet: "We will empty this side now. Is Sticky happy or sad now?"

After the child answered both questions, E put the blocks on the board and the second round begun. After one player received the sticker, the board was put into its initial stage with a new sticker for the next trial to begin. In these trials, both Sticky and the child each won one Sticker.

2.3.2.4. Choice/action. In the other two trials, after the experimenter placed the blocks in the respective bowls she announced that in this round the wheel was *not* spun. Instead the child was asked to pick the side that she wanted to be emptied. As in the other trials the respective blocks from the chosen side were put on the board. Here, the child won the sticker in those trials, in which she favored herself in the first round.

2.4. Counterbalancing

We counterbalanced (1) whether the FB or the desire task was presented first, (2) for the desire task whether the desire/emotion question trials or the action trials were presented first, (3) the side on which the (1;0) option (favoring the child) was placed first, (4) for the desire/emotion question trials whether the child or the puppet won the first round and (5) for the desire/emotion questions whether the child was asked the child or the puppet question first. Over the whole sample we made sure that the five factors were evenly distributed (leading to ~40 children got the FB trials first, ~40 children got the desire/emotion question trials first, etc.).

2.5. Coding

For the false belief tasks children's answers were coded as correct if children gave a correct answer to the test question after successful or corrected control questions. For the desire questions children scored as correct in the incompatible desires condition when they both indicated that they themselves want the arrow to point to the (1;0) side and Sticky wants the arrow to point to the (0;1) side. Respectively, in the competition condition they scored as correct when they both indicated that they want the arrow to point to the (1;0) side and Sticky wants the arrow to point to the (1;1) side. For the desire-dependent emotion questions ("Are you [is Sticky] happy or sad now?") answers were coded analogously. For the choice/action trials children's answer was coded as correct when they chose the (1;0) option favoring themselves. For all four dependent variables the correct answers in the two trials were summed, respectively, each yielding scores of 0–2.

Note, however, that the chance levels for the four variables differ in crucial ways. To score correctly in the desire and emotion questions trials, two questions (for themselves and Sticky), each with a guessing rate of 50 % had to be answered correctly, leading to a chance level of 0.25 for each question and thus a chance level of 0.50 for the sum score. In contrast, for the false belief and the choice trials children had a 0.50 chance to score correctly yielding to a chance level of 1.0 for the sum score.

3. Results

3.1. Plan of analysis

The focus of interest in our study were comparisons between the different modes of indicating desire understanding (explicit questions or active choices) for the different conditions (incompatible desires or competition) in relation to children's false belief understanding. Unfortunately, given different chance levels for the question and choice/false belief trials no direct comparison of the absolute scores between these trials could be computed. As a consequence, to test our hypotheses that children are generally competent in ascribing desires for both conditions even if they do not have an understanding of beliefs, we first analyzed children's actual performance for each mode of indicating desire understanding and payoff-structure separately against the respective performance predicted by chance both for the whole sample as well as separately for the subgroup of children who did not pass the false belief task. Furthermore, we conducted correlation analyses to assess the relation between the different tasks. To test for the hypothesized influences of task complexity we then computed a 2 (condition: incompatible desires or competition) x 2 (type of question: desire or emotion) mixed ANOVA for children's performance in the explicit questions and a *t*-test with condition as the independent variable for the choice trials.

3.2. Performance in the desire and false belief tasks

Children's mean performance in the desire and false belief tasks is depicted in Fig. 2. The whole data set can be accessed at https://osf.io/57cru/?view_only=19cc27fe2a3b40d89162bc9c9fde42ed.

For the whole sample, analyses of children's performance in the desire and false belief tasks revealed the following. For the desire questions, children's correct scores were significantly above the chance level of .50 for both the incompatible desires, $t(41) = 6.55$, $p < .001$, $r = .72$, and the competition condition, $t(38) = 2.13$, $p = .040$, $r = .33$. For the desire-dependent emotion questions children performed above chance level of .50 for the incompatible desires, $t(39) = 2.76$, $p = .009$, $r = .38$,[2] but not for the competition task, $(38) = 1.12$, $p = .268$, $r = .18$, $BF = 4.38$ (Bayes factor for null over alternative).[3] Closer inspection of the pattern of emotion questions in the competition condition revealed that the overall chance performance resulted from the following diverging patterns depending on which side the arrow pointed to. Children performed above chance level of .25 when the (1;0) side (favoring the child) was emptied, $t(38) = 3.57$ $p = .001$, $r = .50$. Their performance, however, dropped significantly below chance when the (1;1) side was emptied, $t(38) = -5.55$ $p < .001$, $r = .67$. Concerning their active choices, children again only performed above chance level in the incompatible desires condition, $t(41) = 3.34$, $p = .002$, $r = .46$, but not in the competition condition, $t(38) = -.85$, $p = .401$, $r = .14$, $BF = 5.65$ (Bayes factor for null over alternative).

In the false belief trials, performance was significantly below chance for children in both conditions, incompatible desires: $t(40) = -4.45$, $p < .001$, $r = .44$[4] ; competition: $t(38)$=-2.24, $p = .031$, $r = .34$.

We then divided the sample in false belief passers, who reliably passed the false belief task (i.e., answered correctly in both trials), and false belief non-passers, who did not pass the false belief task (i.e., answered incorrectly in at least one of the trials). We then analyzed children's performance in the desire tasks for the subsample of non-passers ($N = 60$). The logic behind this approach was to see whether children, who do not yet have a false belief understanding, still perform competently in the respective desire tasks. For the desire questions the non-passers answered correctly above chance level for both the incompatible desires, $M = 1.12$, $SD = .70$, $t(32) = 5.13$, $p < .001$, $r = .67$, and the competition condition, $M = .81$, $SD = .74$, $t(26) = 2.22$, $p = .035$, $r = .67$. For the desire-dependent emotion questions the non-passers answered at chance level in both conditions, incompatible desires: $M = .69$, $SD = .64$, $t(31) = 1.65$, $p = .109$, $r = .28$, $BF = 2.04$ (Bayes factor for null over alternative) and competition condition: $M = .518$, $SD = .51$, $t(26) = .19$, $p = .856$, $r = .04$, $BF = 6.62$ (Bayes factor for null over alternative). For the choice trials the non-passers chose the (1;0) option above chance level in the incompatible desires condition, $M = 1.36$, $SD = .65$, $t(32) = 3.20$, $p = .003$, $r = .49$ but not in the competition condition, $M = .81$, $SD = .79$, $t(26) = -1.22$, $p = .232$, $r = .23$, $BF = 3.33$ (Bayes factor for null over alternative).

3.3. Relation between the tasks

The relation of children's performance across conditions in the different tasks is indicated in Table 1. Controlling for age in months, performance within all the three desires tasks were correlated, all $rs \geq .25$, all $ps \leq .07$. None of the three desire measures, however, correlated with false belief understanding, all $rs \leq .14$, all $ps \geq .23$.

3.4. Influence of task complexity

The 2 (condition) x 2 (type of question) mixed ANOVA with children's correct scores in the explicit questions as DV revealed a main

[2] For two children the data for the desire-dependent-emotion question is missing due to an experimental error.

[3] Bayes factors for t-tests were computed with version 0.9.8 of the BayesFactor package (R version 3.3.2 (2016-10-31)) on i386-redhat-linux-gnu. All Bayes factors are based on the JZS prior, i.e., Cauchy prior on effect size and Jeffreys prior on variance (see Rouder, Speckman, Sun, Morey and Iverson, 2009).

[4] One child refused to participate in the second trial of the FB task, so that no score could be computed.

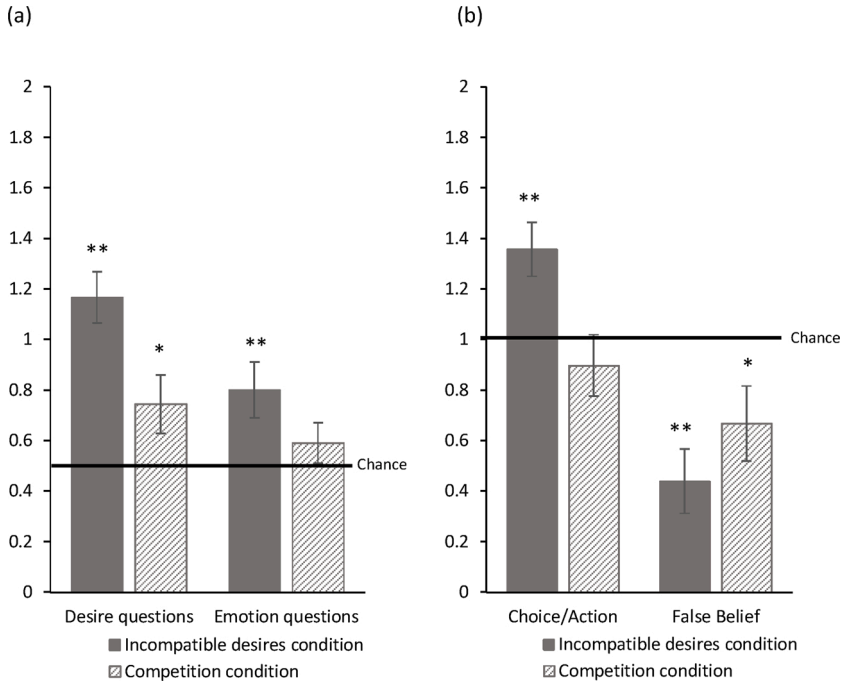

Fig. 2. Mean scores (0–2) for (a) the desire and desire-dependent emotion questions and (b) the choice/action and false belief trials. *Note.* Error bars display +/− SE, asterisks mark significant difference from chance performance: $^{**}p < .01$, $^{*}p < .05$.

Table 1
Raw Correlations (Pearson Correlation Coefficients and Partial Correlations correcting for age in months) between all four dependent variables.

	Emotion questions	Choice/action	False belief
Desire questions	.38** (.34**)	.24* (.25*)	−.05 (−.11)
Emotion questions		.17 (.20^{+})	.24*(.14)
Choice/action			.04 (.05)

** $p < .01$.
* $p < .05$.
$^{+}$ $p < .10$.

effect for type of question, $F(1,78) = 11.02$, $p = .001$, $\eta_p = .12$, a main effect for condition, $F(1,78) = 6.72$, $p = .011$, $\eta_p = .08$, but no interaction between the two, $F(1,78) = 2.03$, $p = .158$, $\eta_p = .03$, $BF = 1.94$ (Bayes factor for null over alternative).[5] For the choice/action trials, children chose the (1;0) option more often for the incompatible desires than the competition condition, $t(77) = 2.85$, $p = .006$, $r = .31$.

4. Discussion

The present study addressed the question how children develop concepts of cognitive versus conative propositional attitudes. In particular, it tested two competing accounts against each other in novel ways. The asymmetry view claims that children first develop an understanding of conative and only later of cognitive propositional attitudes while the symmetry view claims that a proper understanding of conative and cognitive propositional attitudes rests on the same cognitive foundations and thus develops simultaneously. Previous studies comparing children's understanding of subjective desires and beliefs produced inconsistent and inconclusive results. However, the methods of these studies were too different to allow systematic comparisons across studies. The aim of the current study was thus to test between the two accounts more systematically and stringently. To this end, we tested children's understanding of desires in a simplified task, in which we systematically varied the different underlying payoff-structures (incompatible desires (1;0) vs. (0;1) in contrast to competition (1;0) vs. (1;1)) as well as the modes of indicating desire understanding (explicit questions in contrast to active choices) used in previous work.

The main findings were the following: First, children competently ascribed desires to the two agents in both the incompatible

[5] This Bayes factor (BFlinearModel) was computed with version 0.9.12-4.2 of the BayesFactor package (R version 4.0.3 (2020-12-09)).

desires and the competition condition, even if they failed to reliably ascribe false beliefs. Second, children had more difficulties in ascribing desire-dependent emotions than in ascribing desires. Third, children's performance in the desires task was generally more proficient in the incompatible desires than in the competition condition. Fourth, in their active choices children only systematically chose the option favoring themselves (1;0) in the incompatible desires but not in the competition condition.

Altogether, as even those children who did not yet show reliable false belief understanding were able to competently ascribe incompatible and competing desires, the present findings suggest that children come to understand conative before cognitive propositional attitudes and thus favor the asymmetry view. Concerning the tension between the diverging results of previous studies, our results suggest that this divergence is mainly a function of performance factors related to the measures of desire understanding. In particular, children's competence varied strongly as a function of measures of desire understanding (such that children answered questions about desires correctly even though they did not put this understanding to use in competitive moves).

But do the present findings not also, in some other respects, speak for the symmetry account? What about the fact that though children correctly ascribed desires for both types of payoffs, their general performance in the incompatible desires condition was still higher than in the competition condition? Furthermore, they generally failed to ascribe desire-dependent emotions in the competition condition when the critical (1;1) option was selected. Does that indicate that children might solve incompatible desires with a simpler strategy that does not involve considering both subjective desires simultaneously? Not necessarily. In fact, there are several good reasons that imply that these differences might actually stem from external (performance) factors.

First of all, the (1;0) vs. (1;1) payoff-structure is clearly more complex concerning working memory demands since it involves more objects to keep track of. Second, children's competitive desires might have stood in conflict with their prosocial tendencies. Previous research has shown that being confronted with two options ((1;0) or (1;1)) and a second recipient who vocalized her desire to get some share, in non-competitive conditions even 2-year-olds tend to take the recipient's need into account and choose the (1;1) option (Brownell, Svetlova, & Nichols, 2009). Given that in our game the puppet also clearly verbalized her desire to win the sticker, children's understanding of the right competitive choice (1;0) potentially stood in direct conflict with their prosocial tendencies to choose the (1;1) option.

Third, children's lower performance in the competition condition might also be an indirect result of the task structure. Though each trial consisted of two rounds we assessed the indicators of desire understanding only in the first round (i.e., when both the child and the puppet still needed two blocks to reach the sticker). The reason behind this is that, unless one accepts a tie, at some point in a competition the (1;0) vs. (1;1) structure necessarily turns into a (1;0) vs. (0;1) structure: in the end, only one person wins and the other one loses. In our small two-step game already the second round determined the winner of the desired sticker and could thus easily be re-conceptualized as a (1;0) vs. (0;1) structure. In other words, this means that only the first round could yield unambiguous results for an understanding of the (1;0) vs. (1;1) payoff. Though there was thus good reason for assessing the indicators for desire understanding in the first round, this might have also worked against the production of correct answers: even after choosing the (1;1) option in the first round, there was still a good chance of ending up winning the sticker in the next round since choosing the (1;0) option in one of the two rounds would be sufficient to win. Likewise, after the arrow pointed to the (1;1) option there is no real reason to be sad yet – and this may have led to children's below chance performance in ascribing "correct" desire-dependent emotions in that case.

Now, given these practical issues with the competition task, it seems even more impressive that even 3-year-olds who did not pass the false belief task (i.e., children who do not have an understanding of others' beliefs yet) mostly ascribed desires correctly in the competition condition.

In sum, from an empirical point of view, the present findings supply evidence for an asymmetry in children's understanding of conative before cognitive propositional attitudes. And they do so even under the premise that a competitive payoff-structure reflects the right task to measure a subjective understanding of desires. From a theoretical point of view, however, it remains an open question for future discussion whether this premise is indeed justified or whether, alternatively, children's proficient understanding of truly incompatible desires is already a solid foundation for this conclusion.

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