Editorial

Implicit and explicit theory of mind: State of the art

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From their different vantage points, the contributors to this issue address the developmental puzzle of infants as young as 14 or 15 months (Onishi & Baillargeon, 2005; Surian, Caldi, & Sperber, 2007) displaying sensitivity to people’s mistaken false-belief-based behaviour in certain tasks, when it has proved difficult to show any such understanding before 3 or 4 years (Wellman, Cross, & Watson, 2001) in many variations of the traditional false-belief test (Wimmer & Perner, 1983). Borrowing from the consciousness literature, these classes of tasks can be called indirect and direct tests. In the traditional false-belief test and its variations, children are directly asked about the mistaken agent’s belief or behaviour, while in the tasks used with young infants any understanding has to be inferred indirectly from infants’ or toddlers’ spontaneous behaviour in the test situation. Baillargeon, Scott, and He (2010) used the cognate characterization of induced as opposed to spontaneous responding. Understanding shown in an indirect test when no such understanding is shown on the direct test is one of the hallmarks of implicit or unconscious knowledge (Merikle & Reingold, 1991). On these grounds, Perner and Clements (2000) spoke of implicit understanding of belief. The implicit–explicit distinction has however become a general expression of marking the intuitive difference between an inchoate earlier and a more robust later understanding.

The Nature of Development: Negative Release or Positive Gain

One can caricature two basic positions of what underlies the observed cognitive changes. One view assumes that knowledge of basic principles (core theory) is present early on but infants and young children cannot make full use of it because of constraints external to the content of their knowledge. These constraints may be limited memory capacity or insufficient inhibition of interfering processes. Only when children are released from

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these negative constraints can they use their knowledge in increasingly complicated tasks. The contrasting view is that development consists in a positive gain of new principles being discovered or maturing. As a specific case of this dichotomy, San Juan and Astington (pp. 105–122, 2012) mention nativist modular accounts in distinction to constructivist conceptual shift accounts.

As an example of negative release, Baillargeon et al. (2010) contend that standard direct false-belief tasks tap not only the false-belief representation system but also children’s skills in inhibiting their own perspective and selecting a response to the direct test question. This account posits that only the psychological reasoning system is engaged in indirect false-belief tasks where expectant or anticipatory looking is measured. This cannot explain why Clements and Perner (1994) found no evidence of correct anticipatory looking in children younger than 2 years 11 months. He, Bolz, and Baillargeon (pp. 14–29, 2012) raised the possibility that this may have been due to the use of a ‘I wonder where he will come out?’ prompt, which children below age 3 may have understood as a direct question, which turned the task into a direct task. To help children, the authors added a spontaneous false-belief condition where the experimenter delivered the anticipatory prompt as a self-directed utterance (stared at ceiling with chin in hand) and compared it to a question condition where the experimenter looked directly at the child when uttering the prompt. Two-and-a-half-year-old children looked longer at the original (belief relevant) location in the self-addressed experimenter utterance condition than in the question condition.1

The approach complements German and Cohen’s (pp. 45–58, 2012) emphasis on cue encoding, which advocates characterizing the matrix of contextual input information (e.g., self-directed utterance vs. direct question) that engages the theory of mind (ToM) network. Also, the finding by Surian and Geraci (pp. 30–44, 2012) supports an early competence view. Seventeen-month-olds showed correct anticipatory looking in a false-belief situation even when the ‘agents’ are morphologically very different from familiar or natural agents. They contend that evidence of early attribution of beliefs to geometric shapes weakens the possibility that domain general associative mechanisms, fed by learning experiences involving familiar human agents, play a crucial role in the development of children’s psychological reasoning system.

A different explanation assumes positive gain. The performance lag on the two sets of false-belief evidence – spontaneous looking in indirect tasks and elicited verbal2 prediction in direct tasks – suggests the operation of two distinct systems of understanding: an early-developing implicit system that is piecemeal and unconscious and a later-developing explicit system that is abstract and conscious (Low, 2010). Proponents of the positive gain view differ in terms of how they flesh out the meaning of ‘implicit’. Rakoczy (pp. 59–74, 2012) cautions that it may be of limited explanatory help to call some precocious abilities in infants ‘implicit ToM’ without further qualification.

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1 This result is undoubtedly interesting but the tasks are not ‘anticipatory looking’ tasks as used by Clements and Perner (1994), where the agent (or the agent’s hand, Southgate, Senju, & Csibra, 2007) reappears at different locations so that the child’s looking anticipates where the agent will reappear. While in this study children’s longer looking at the object’s original location is not an obvious indicator of any action by the agent. In fact, Garnham and Perner (2001) separated the location of the object from the agent’s point of reappearance and found only looking at the point of reappearance and not to the object’s former or present location.

2 Data by Garnham and Perner (2001) suggest that non-verbal behaviour such as moving a mat to the point of the agent’s return pose the same problem unless it occurs spontaneously without much reflection in analogy to action based on implicit knowledge in the consciousness literature (Perner & Clements, 2000).
Rakoczy alerts us to the fact that we lack data to establish whether infants’ apparent sensitivity to false-belief inducing situations warrants ascription of beliefs about beliefs. Infants’ sensitivity may not be inferentially sufficiently integrated to warrant either the inference that what they are sensitive to are beliefs of the agent, or that their sensitivity is a belief or some ‘subdoxastic’ state (Stich, 1978). It is particularly difficult to pinpoint whether infants operate with a full-blown unconscious concept of belief or with simpler psychological states that play a role in the causal history of beliefs but are not beliefs themselves.

Apperly and Butterfill (2009) favour the view that there may be an efficient early-developing implicit system that tracks intermediate 'belief-like' states (sensitivity to another’s engagement to or registration of an object or event), and such understanding may be revealed in spontaneous or indirect measures. This view is promising insofar as one is able to pinpoint real limits on the kinds of input that the implicit system will process. Qureshi, Apperly, and Samson (2010) tested Level-1 perspective taking whereby adults had to judge how many dots an avatar could see. In the critical self-trials (which serve as an indirect measure of taking the other person’s perspective), adults were slower and more error prone in judging their own perspective when the avatar had a different perspective of the number of dots than when his perspective was the same as theirs. This interference suggested that adults were efficiently processing the avatar’s perspective even though it was not required for their own explicit predictions (which make it an indirect assessment of other’s perspective). On the basis of such findings, Surtees, Apperly, and Butterfill (pp. 75–86, 2012) tested Level-2 perspective taking by inviting 6- to 11-year-olds and adults to make judgments about the appearance of numerals that appeared different depending on viewing position (e.g., 6 and 9 painted on the floor between themselves and the avatar). No interference was found on the self-trials when the avatar's perspective of the numerals was different from the participants'. There was only evidence of interference of participants’ own perspective on the direct measure of Level-2 perspective taking. Thus, Surtees et al. view the Level-1/Level-2 distinction as one signature limit on implicit, automatic perspective taking. However, in reviewing the automaticity literature, German and Cohen (2012) alert readers to other evidence pointing to a neural signature of ToM that occurs even when there is no value or need to track others' belief for task performance.

A new paradigm developed by Kovács, Téglás, and Endress (2010) is also attracting debate amongst contributors as to whether there is genuine conceptual gain in belief understanding. In Kovács et al.’s task, 7-month-olds viewed the following scenes with a Smurf agent observing a ball move behind a barrier. In a false-belief condition, the Smurf left, and the infants witnessed the ball moving from behind the barrier and leaving the scene. Thus, the Smurf falsely believed there was a ball behind the barrier. The Smurf returned and the barrier was lowered to reveal (to the Smurf’s but not the infant’s surprise) the ball. In the true-belief condition, the Smurf also saw the ball leaving the scene, and hence shared this knowledge with the infant. Infants looked longer at the ball behind the lowered screen in the false-belief condition when this was surprising for the Smurf than in the true-belief condition. The authors argued that this showed that infants computed the Smurf’s belief online. Parallel results were obtained with reaction times in adults. There, the effects did not hold when the Smurf was replaced by a pile of boxes. These findings epitomizes the cue-encoding approach for German and Cohen (2012), where the presence of an agent is one critical cue to meeting input conditions for triggering ToM computations.
Surian and Geraci (2012) see the results by Kovács et al. (2010) also as a successful extension of the earlier findings by Onishi and Baillargeon (2005) and Surian et al. (2007) on older infants to a much younger age. However, Ruffman, Taumoepeau, and Perkins (pp. 87–104, 2012) point out that in this task, the infant’s looking does not constitute a prediction of, or a response to, a character’s search behaviour. The effect on looking time may, therefore, not be caused by representing a belief that governs the Smurf’s behaviour, but by registering the Smurf’s differing perceptual access (which would be needed for computing his beliefs about the ball). In other words, infants may be very sensitive to registering what happened in the presence and what happened in the absence of an agent. The representation that the ball was still behind the screen when the Smurf was present could be the cause of infants longer looking as much as representing the Smurf’s belief about the ball’s location (Perner, in press-a).

Ruffman et al. (2012) are also less sanguine about rich interpretations of data from a range of tasks meant to tap infants’ understanding of goals and intentions. They argue that infants use experiences of behaviour sequences (supported by statistical learning skills) rather than mental states to reason about outcomes. Short of children offering verbal explanations with overt mental-state terms when justifying their predictions (‘because that’s where Maxi put the chocolate’ vs. ‘because he thinks it is still there’ – the latter is rare even after 6 years of age) looking responses may indicate a shallow causal understanding of how people act in certain situations (based on smart encoding, Perner, 2010, or behaviour rules, Povinelli & Vonk, 2004) rather than a deep analysis in terms of intervening mental states. Thus, children’s looking responses may be based on situation-action rules that provide an implicit sensitivity to actions (mentally caused behaviour) without explicitly representing the mental intermediates in the causal chain from situation to action.

Their explicit understanding of how people act and why may be grounded in teleology, that is, action that objectively achieves a worthy goal. This is a plausible explanation for why children give systematically wrong answers in the standard false-belief test, for Mistaken Maxi has good objective reasons to go where his chocolate actually is. The developmental consequence is that children become able to understand false-belief tasks at around 4-years when they understand different perspectives (Perner, Mauer, & Hildenbrand, 2011) and that agents do not act according to objective reasons but according to their subjective reasons that present themselves as objective reasons within the agent’s subjective perspective (Perner & Roessler, 2010).

**Behaviour and Mental-State Rules**

Mental-state rules are computational behaviour–mind–behaviour rules, which a mentalist (mind reader) needs to infer from an agent’s observable situation and behaviour the agent’s mental states – beliefs and desires – and from these states what the agent is likely to do. The rules by which we predict and explain behaviour (mind to behaviour) are – so is commonly thought – accessible to us and they can be formulated as practical syllogism (Aristotle, see Kraut, 2009; Gopnik & Meltzoff, 1997): ‘people take those (instrumental) actions of which they think they will achieve what they want (their goal).’ The rules that lead from observed behaviour to mental states, on the other hand, tend to be opaque to us but must exist in our sub-personal cognitive mechanism in order for our ToM to work. Behaviour rules (Povinelli & Vonk, 2004) are of this sub-personal kind. Instead of leading from behaviour to mental states they lead directly to predicted behaviour. Povinelli and
Vonk argued that any mentalist explanation of making correct behavioural predictions can easily be changed to a behavioural rule explanation by simply taking the mental step out of the explanation and substituting it with a direct predictive link to the future behaviour. In other words, a behaviour rule explanation can account for the same set of behavioural predictions as a ToM approach. The two are computationally equivalent and they therefore cannot be distinguished by investigating what kind of predictions one can make but only by using cognitive measures that tap how these predictions are made (e.g., Perner, 2010; see also Ruffman et al., 2012).

With this background in mind, the reader can critically evaluate the proposal by He et al. (2012) who analyse the mental state approach as involving but one general rule: agents who are pursuing a goal will act on information available to them. He et al. admit that, by other measures, mental rules will be more complex by involving an additional step than situation-action behaviour rules, but they maintain that, overall, ‘far fewer [mentalistic] rules will be needed across situations’ because mentalistic rules are general and apply to a variety of situations. Surian and Geraci (2012) concur and argue that a behaviour rule account would have to concoct more and more situation-action rules that would explain the looking times found in different studies. That this should be so is not immediately apparent, since for existing studies every behaviour-mental rule can be turned into corresponding behaviour-behaviour rule (Povinelli & Vonk, 2004). In any case, even if an unruly concoction of behaviour rules is needed to predict behaviour, why would this count against behaviour rules? Evolution, we are told, does not select for elegant systems but for fast and dirty rules (Gigerenzer, 2004).

San Juan and Astington (pp. 105–122, 2012) caution that it is not even clear that children of a given age apply their implicit knowledge or understanding across situations. Although behaviour rules can apply to verbal predictions as well, there is wide (perhaps premature) agreement that from around age 4, children (in different cultures as well) pass different false-belief tasks at the same time (e.g., unexpected transfer, unexpected contents, misinformation, appearance reality), and are able to deploy their attributions for different uses or demands (e.g., judging where agents will look for, where they will think, what they will say, where they will point to; see Wellman et al., 2001). It is this flexible combination of different belief-inducing situations and different purposes that is most telling of a ToM over behaviour rules (Perner, 2010). Studies examining infants have used a variety of belief-inducing situations but only a very limited number of purposes, for example, where someone will go or reach. Moreover, infant studies with looking duration are rarely conducted using a within-subjects design, qualifying the claim that early understanding generalizes across situations even further (Low & Wang, 2011; Rakoczy, 2012; San Juan & Astington, 2012).

Whilst there is some diversity in false-belief formation scenarios tested across violation-of-expectation studies, anticipatory looking data are based only on the unexpected-transfer scenario (Low & Wang, 2011). Wang, Low, Jing, and Qinghua (pp. 123–140, 2012) used a within-subjects design to test whether Mainland Chinese preschool children would also show dissociation between anticipatory looking and verbal predictions across different belief-inducing contexts at the same time: unexpected transfer, unexpected contents, and misinformation. Individual Chinese 3- and 4-year olds showed accurate anticipatory looking across the false-belief task contexts despite erring on their explicit verbal predictions. Individual children’s anticipations cohering across diverse false-belief scenarios would fit with He et al.’s (2012) analysis that only one general rule is required under the mental state approach – but only at a high level of analysis. The cognitive apparatus must also solve the lower level analysis getting from
observables to mental states. Thus, based on Perner's (2010) analysis of mental state and behaviour rules, behaviour rules would also (and better) explain Wang et al.'s data showing children's accurate anticipations across scenarios. Depending on how one analyses or counts rules, advocates of either a rich or lean interpretation can claim to have parsimony's support on their side (for whatever that is worth).

Vierkant (pp. 141–155, 2012) argues that infants compute false belief and the representation guides awareness into intentional action - best showcased in active helping and referential communication studies by Buttelmann, Carpenter, and Tomasello (2009) and Southgate, Chevallier, and Csibra (2010), respectively. He suggests that verbal reporting - as is often the case in traditional false-belief tasks - may be misleading as the gold standard for ascribing mental-state awareness. Even those studies are open to behavioural interpretations. Consider Buttelmann et al.'s false-belief condition. An agent fails to witness her favourite toy being moved and returns to the first box to retrieve it but could not get to open the box. Children were then asked to 'help' the agent: over 70% of 18-month-olds approached the second box. In contrast, less than 20% did so in a knowledge condition where the unsuccessful agent had witnessed the transfer to the new box but tried to open the empty box. Buttelmann et al. suggested that toddlers approached the second box in the false-belief condition because they recognized that the agent falsely believed that her toy was still inside the first box and concluded from the agent's unsuccessful attempt to open that box that she wanted to retrieve the toy she thought was in that box but that was now in the new box. So, the child had to orient to the new box to retrieve the desired toy. Instead of concluding that toddlers have a concept of belief as such, Buttelmann et al.'s findings can also be explained with recourse to the notion of belief-like or knowledge-like states such as acquaintance, engagement, or registration (Doherty, 2011; Apperly & Butterfill, 2009). The child directs the experimenter in the false-belief condition to the second box because the experimenter has not been acquainted with the fact that the object is now in this box.

Another behaviour-based explanation might be: children expect people to look for an object where they last saw it, as happens in the false-belief condition. So, they infer that the agent is looking for the object and help him to get to it by pointing to the other box. In the control condition, the agent is not looking where he last saw the object, so he cannot be looking for the object but must have some other goal (to open the box he is trying to open).

In Southgate et al.'s (2010) study, 17-month-olds watched an agent place two novel unnamed objects in two separate boxes. Unbeknownst to the agent, the contents were then switched. In Experiments 1 and 2, when the agent returned, she pointed to a box (the incorrect box in the false-belief condition) and said: 'Do you remember what I put in here? There's a sefo in here. There's a sefo in this box. Shall we play with the sefo?' In the false-belief conditions, children correctly chose the item in the other box not the one the experimenter pointed to. The authors' interpretation is that children understood that the experimenter wanted from the indicated box the object she thought was in there and not the one that was actually in there. But whatever a mental-state rule can do to prompt helping action a situation-action behaviour rule, 'people want from a box what was put in there in their presence', can do as well.

Yott and Poulin-Dubois (pp. 156–171, 2012) and Thoermer, Sodian, Vuori, Perst, and Kristen (pp. 172–187, 2012) adopt more sensitive approaches to differentiate between interpretations. Yott and Poulin-DuBois taught 18-month-old infants a new rule to expect that an object is not in the last place it was seen. Then, participants were administered
a critical false-belief condition trial from Onishi and Baillargeon (2005). Yott and Poulin-Dubois reasoned that, if activation of behaviour rules plays a critical role then, after learning the new rule, infants should also expect the agent in the false-belief trial to search in the full box and not the empty box. The results indicated that infants looked longer when the agent reached for the object in the full box compared to when she reached in the empty box (replicating Onishi and Baillargeon). Yott and Poulin-Dubois resist temptation to adopt a rich interpretation of their findings. The new rule was only taught over a couple of trials and may not be sufficient to override the greater probability of the general rule (built up over 18 months of learning) that objects are typically in the last place observed.  

Yott and Poulin-DuBois (2012) also report limited inter-task coherence: infants’ duration of looking time in the false-belief trial (full box condition) marginally correlated with infants’ ability to predict others’ unfulfilled intentions. Thoermer et al.’s (2012) longitudinal study shows in one respect remarkable continuity. In unexpected-transfer scenarios anticipatory looking at 18 months was strongly correlated ($r = .50$) with children’s verbal predictions at 4 years (stayed significant even with verbal intelligence partialled out). However, there was little correlation with verbal predictions on an unexpected-contents task at 4 years. Even the correlation between the transfer and the contents tasks at 4 years was remarkably low, which raises the suspicion that even performance on the standard false-belief tests are dominated by shallow behaviour rules rather than a coherent ToM. So, not only the infants’ but also 4-year-old children’s reasoning system may lack the necessary degree of inferential integration for holding a proper ToM as Rakoczy emphasizes.

**Executive Function and Language**

A popular argument for the negative-release approach for why children below 3 or 4 years fail the traditional false-belief test is that inhibition requirements in that task mask conceptual competency. By taking away these inhibition difficulties, in the indirect tasks reveals early ToM cognition in infants. Wang et al. (2012) compared implicit anticipation and explicit prediction responses when the target object was present or absent. Manipulation of object presence/absence had a rather small effect in the expected direction on children’s explicit judgments. However, this effect was about the same (or slightly larger) for the implicit anticipation measure. This finding poses a challenge to explaining the dissociation between looking responses and verbal judgments by claiming that direct tasks but not indirect tasks are subject to the distracting influence of knowing reality. However, Wang et al. also found that separate measures of executive functioning correlated with children’s direct judgments and not with their indirect visual anticipations (regardless of executive demand – object present or absent), which does speak to the possibility that direct judgments have executive demands that indirect looking responses lack. A unifying solution for the study’s opposing messages might be that there are alternative explanations for the link between traditional false-belief

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3The teaching phase was not done with Onishi and Baillargeon’s (2005) set up for the false-belief test, which had a yellow and a blue box; Yott and Poulin-Dubois’ (2012) rule-training task was done with an orange and blue box. The training may not have taught a general behaviour rule (an object is not in the last place it was seen) but a fact about the orange box (i.e., that objects put inside end up in the blue box). But since the familiarization trials in the false-belief task followed Onishi and Baillargeon, infants are still being taught in that set up that the object stays in the box where one last put (last saw) it. Yott and Poulin-Dubois acknowledge such concerns and their rule-training approach will need improvement to better illuminate the role of behaviour rules for explaining behavioural responses on the false-belief task.
measures and executive tasks (Perner & Lang, 2000), for instance a common meta-representational insight.

To the extent that visual anticipations reflect an implicit non-propositional mind-reading system sensitive to ‘belief-like’ states (Surtees et al., 2012; Rakoczy, 2012), Wang et al. (2012) suggest that the development of executive functioning partly helps make emergent a later-developing explicit mind-reading system capable of ascribing mental states with propositional content. However, the parallel onset of anticipatory looking across different tasks does not exclude that it could be driven by preschoolers’ skills at detecting statistical co-variation patterns (Ruffman et al., 2012).

Studying a population where executive function and explicit false-belief skills do not develop at the same age as in normally developing children helps gain a clearer picture of the developmental relationships between these measures. P. de Villiers and J. de Villiers (pp. 188–209, 2012) compared oral deaf and hearing children’s performance on deception and direct false-belief tasks in relation to executive function and complement syntax mastery. Whilst both groups did not differ significantly in either their executive or deception task performance (after controlling for their 11/2 year difference in age), the deaf participants were significantly delayed on direct false-belief tests. In both groups, hearing and deaf, false-belief understanding was strongly related to understanding say-complements, but not to conflict inhibition, while deception was strongly related to conflict inhibition but not say-complements. P. de Villiers and J. de Villiers discuss that the responses to deception tasks – on a par with indirect looking responses in false-belief tasks – can be handled by situation-action behaviour rules. Their view is that complex language (measured with say-complements) allows representation of propositional attitudes that enables passing the traditional false-belief test. Performance on indirect false-belief tasks that escapes the requirements of linguistic propositional representation is less sophisticated. This view gains some support from the finding by Yott and Poulin-DuBois (2012) that 18-month-olds’ looking time on the violation-of-expectation false-belief trial correlated with performance on a measure of inhibition, and from the finding by Low (2010) that understanding complementation correlated with preschoolers’ direct false-belief judgments but not their visual orienting.

Language can help with the emergence of belief-desire reasoning in other ways. San Juan and Astington (2012) explain that language and executive function can interact to bridge the gap between the time when children reason implicitly and when they reason explicitly about false belief. Assuming that children start by implicitly representing patterns of behaviour or belief-like or knowledge-like states, then repeated pairing of epistemic verbs and/or their complement frames with those initial representations can help children to abstract and remember the content of these representations, and to uniformly encode and compare abstractions across contexts, leading to the formation of explicit and generalizable representations. Generalizability is of core concern to possession of mental concepts such as belief (Rakoczy, 2012; Vierkant, 2012). As such, the acquisition of epistemic language supports performance on standard false-belief tasks and, critically, cultivates meta-representational understanding.

**Comparative Perspective**

Couchman, Beran, Coutinho, Boomer, Zakrzewski, Church, and Smith (pp. 210–221, 2012) discuss how responses to doubt and uncertainty ground meta-cognition research and, in turn, inform ToM research relating to self-awareness and consciousness. In perceptual discrimination tasks with an option to opt-out of a primary task, dolphins...
and old world monkeys increased their opt-out responses in the same way as humans did as discriminations became more difficult and success rate on the primary task decreased. Granting these animals meta-cognitive abilities of attributing mental states to themselves (see Carruthers & Ritchie, in press; Perner, in press-b, for a more cautious interpretation) raises an interesting challenge for German and Cohen's (2012) emphasis on cue encoding. What are the cues that trigger meta-cognition, or are meta-cognition and theory of other minds two distinct systems?

Of the non-human species argued to exhibit meta-cognition, few, if any, exhibit false-belief understanding (Call & Tomasello, 2008). For Couchman et al. (2012), the comparative evidence supports the hypothesis that meta-cognition emerged prior to ToM. Cross fertilization has barely begun. Balcomb and Gerken (2008) used the opt-out paradigm on 2½-year-old children and found earlier evidence of meta-cognition about own ignorance than when children are asked directly (Rohwer, Kloo, & Perner, in press). Meta-cognition (like false-belief understanding) may have primitive forms that precede its explicit counterpart. Even so, Couchman et al. advise against simple categorical answers when differentiating transitional forms of meta-cognition – uncertainty responses, whilst defined as implicit, might have an emerging explicit mind producing them (see also Vierkant, 2012).

Survival Pack: Glossary of Useful Distinctions

All contributions of this special issue centre around the question why very young children and infants who consistently fail to show any understanding of belief on the traditional direct false-belief test, nevertheless, do show some sensitivity to belief on indirect measures. Before releasing the reader into the details of the assorted contributions, we thought it helpful to give a last overview of all the different distinctions some of which we have mentioned above and some will be encountered the first time in the texts. Many come from outside Developmental Psychology (Consciousness Research and Philosophy of Mind) and may be quite unfamiliar to many readers:

1. Unified body of knowledge – two (multiple) systems
   Is the early understanding part and parcel of the later understanding or are early and late understanding based on independent systems (bodies of knowledge)?

2. Implicit – explicit understanding
   (a) Unconscious – conscious
   (b) Procedural – declarative knowledge
      Procedural knowledge can only be activated online when the relevant situation occurs. Declarative knowledge enables conditional deliberation: if a person were given wrong information she would believe . . .
   (c) Non-conceptual – conceptual
      Faced with two colour patches of slightly different hue, one can see the difference, so one must represent the different hues but has no concept to either express which is which or remember it, and so cannot judge whether
a later presented patch is of the same or a different hue. In contrast, if one patch is bluish the other reddish, then I can express the difference and remember it.

(d) Automatic – spontaneous – controlled

When something (knowledge, action) tends to be triggered (e.g., what another person believes) by a certain situation then we can distinguish the following cases. If it is automatic, it is difficult or impossible to prevent it from being triggered. If it is spontaneous, it can be stopped at will. Controlled knowledge or action is not triggered spontaneously but needs to be willed.

3. Innate – learned

The content of innate knowledge is provided by the genes, although it probably needs interaction with the environment to be activated. Learned knowledge gets its content and structure from the structure of the experienced environment.

4. Modular – central process

The two most important features (see Fodor, 1983 for complete list) of modular processes is that they contain knowledge that is available only for the process (encapsulation) and cannot be altered by having knowledge to the contrary (impenetrability), for example, the lines of the Müller-Lyer illusion still look different even when one knows that they are the same length. Central processes, in contrast, contain knowledge that can be altered by new information and can be used for discussion.

5. Causally shallow – deep understanding (behaviour rules – mental state rules)

Behaviour rules encode causal dependencies of future behaviour on behaviour in a current situation. This is a shallow causal link between two observables. Mental state rules provide a deeper understanding of how this causal connection works: the current situation creates a mental state in the individual, which then causes the individual to act in the predicted way.

6. Law-like (nomic) generalization – reasons for acting

Nomic generalizations provide knowledge (of how people will act) that is based on existing regularities (abstracted from observation or given by evolution). Reasons for acting provide insight into what a person should do in a given situation and, therefore, most likely will do so.

A word of caution: these distinctions are often seen as packages. For instance, behaviour rules (because of their unfortunate association with ‘behaviourism’) are taken to be learned while a ToM, especially when combined with modularity, is taken to be innate. We advise to resist tacit assumptions of this kind: behaviour rules could be provided innately by evolution, while a ToM could be acquired through experience (theory formation). With this advice, off you go!

References


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