Mental files theory explains why children pass many perspective taking tasks like the false belief test around age 4 (Perner & Leahy, 2016). It also explains why older children struggle to understand that beliefs about an object depend on how one is acquainted with it (intensionality or aspectuality). If Heinz looks at an object that is both a die and an eraser, but cannot tell by looking that it is an eraser, he will not reach for it if he needs an eraser. Four-to 6-year olds find this difficult (Apperly & Robinson, 1998). We tested 129 35- to 86-month olds with a modified version of Apperly and Robinson’s task. Each child faced four tasks resulting from two experimental factors, timing and mode of information. Timing: Children saw Heinz learn the die’s location either before or after they learn that the die is an eraser. Mode of information: Heinz learns where the die is either perceptually or verbally. When Heinz’ learning is verbal, he never perceives the die at all. We found that Apperly and Robinson’s problem occurs only in the seen-after condition, where Heinz sees the die after children had learnt that it was an eraser. It vanishes when Heinz learns where the die is before children learn that it is also an eraser. The problem also vanishes when Heinz learns where the die is purely verbally (e.g., “The die is in the red box”) and never sees it. This evidence lets us refine existing mental files theory, and eliminate several alternatives from the literature.

1. Introduction

Labels influence the ways we think about objects. This is particularly salient for objects with dual functions. For instance, a rubber die that can be used to erase pencil marks is both a die and an eraser. So it can be thought of (or spoken of) as a die or as an eraser. Three year old children have problems with multiple identities like this. This explains children’s reluctance to use different names for the same object (Flavell, 1988; Markman, 1989; Markman & Wachtel, 1988: mutual exclusivity bias) and their problems making the appearance-reality distinction (Flavell, Flavell, & Green, 1983). Dual identities give rise to identity statements like “The die is the eraser”. This statement is informative when one has learned about the die and eraser separately, but does not know they are the same object. Three year olds have problems making sense of such statements. Psycholinguists (Clark, 1997; Tomasello, 1999) note that calling an object by a different name (label) puts a different perspective on the object. So it is interesting that children’s problems with identity statements relate to their problems understanding another person’s perspective in the traditional false belief task (Perner, Mauer, & Hildenbrand, 2011). When one object can be thought of in multiple ways, we will say that there are multiple possible conceptual perspectives on that object.

Understanding that others may think of an object under one conceptual perspective but not another is even more difficult. Russell (1987) first explored this issue. In his stories George realizes that his watch has been stolen. Children learned that the thief had curly red hair and were asked, “Can we say that George was thinking: ‘I must find the man with the curly red hair who stole my watch?’”. Children up to 6 or 8 years find such judgements difficult (Kamawar & Olson, 1999, 2009, 2011). Apperly and Robinson (1998, 2001, 2003) avoided asking for explicit metalinguistic judgments in their Heinz scenario. Four- to 6-year-old children were shown a rubber die, which they identified as a die. They were then shown that the die was also an eraser. Puppet Heinz entered the scene and observed with the child that the die/eraser was put into one box and a standard eraser into another box. At this age most children pass the false belief test; when asked, “Does Heinz know that the die is an eraser?” they mostly answered correctly with “no”. Yet when asked, “Where will Heinz go to get an eraser?” they indicated the location of the die/eraser as often as the location of the standard eraser.
Sprung, Perner, and Mitchell (2007) and Perner, Huemer, and Leahy (2015) found that this pattern occurs in a developmental window between passing first-order false belief tasks and passing second-order belief tasks about 2 years later. We refer to these children as “(+ −)” because they pass the first-order test but fail the second-order test. This was tested as follows: Max puts his chocolate into box 1 and leaves. The chocolate is moved to box 2. Max returns; children face two test questions: (1) “What will Max say if we ask where his chocolate is?” (2) “What will Max say if I ask whether he knows where his chocolate is?”. Correctly answering (1) requires that participants understand where Max thinks his chocolate is; a first-order problem. Correctly answering (2) requires that participants understand that Max thinks that he knows where the chocolate is; a second-order problem.

Mental files theory (Perner et al., 2015) explains the curious pattern of responses in the Heinz scenario by distinguishing that an object is conceived under a particular concept from the information one has about the object. A dual object like the die/eraser can be conceived of as a die (represented in the mind by a file headed “die”) and as an eraser (represented by a file headed “eraser”). These files, which store the participant’s information about objects in the environment, are called regular files. The regular die-file records the object’s qualities as a die, e.g., that it is in box 2 and that it rolls quietly, as well as perceptual information that helps the child recognize the object at later times. The regular eraser-file records its qualities as an eraser, e.g., that it is in box 2 and that it erases poorly (smudges the paper), again along with recognition information. Fig. 1 illustrates this for the Heinz scenario (including a regular file for the standard eraser). Each file holds information that enables the participant to recognize and re-identify the object it tracks. The two files that track the same object (die/eraser) in Fig. 1 are linked by a double arrow, which captures the participant’s understanding that the die is also an eraser. Because the files are linked, the participant has access to all information contained in one file (e.g., the die-file) even when thinking about the object from the other conceptual perspective (e.g., as an eraser).

According to mental files theory, agents use another kind of file, vicarious files, to model another agent’s perspective on the world. Vicarious files are indexed to the agent whose beliefs they track. Much as regular files store information about objects the child is tracking, vicarious files store information about the objects that the child sees other agents tracking. So as the child’s perspective is reflected in her regular files, the agent’s perspective is reflected in her vicarious files.

When a child sees an agent track an object, she must vertically link the vicarious file indexed to the agent to her regular file for the same object, thereby marking that the two files track the same object. Vertical links, unlike links between regular files, allow only restricted flow of information. In the Heinz scenario there will be a vicarious eraser-file indexed to Heinz and vertically linked to the regular file for the standard eraser (Fig. 1, upper left). There will also be a die-file indexed to Heinz and linked to the regular die-file for the die/eraser. The file contains Heinz’ information about the dual object when conceived of as a die, e.g., that it is in box 2.

Mental files theory proposes that (+ −) children make systematic errors in managing this filing system. These errors explain why (+ −) children say that Heinz does not know that the die is an eraser, but act as though he might reach for the die when he needs an eraser. We know that children develop an understanding of knowledge formation through visual perception between 3 and 4 years of age (Hogrefe, Wimmer, & Perner, 1986; Sodian, Thoermer, & Dietrich, 2006). So (+ −) children recognize that Heinz cannot learn that the die is also an eraser by just looking at it. Hence, they correctly leave out the information “is also an eraser” on the vicarious die-file and answer the question, “Does Heinz know that the die is an eraser?” correctly with “no”.

However, (+ −) children create too many vicarious files (see Fig. 1, where a vicarious eraser-file is crossed out to mark its illegitimacy). This gratuitous vicarious file misleads children: When asked where Heinz will look for an eraser, they check the vicarious files for Heinz, find two files headed “eraser”, and choose one of them at random.

![Fig. 1. Mental files analysis of Apperly and Robinson’s (1998) Heinz scenario for (+ −) children. The child, seeing the scenario, has a regular file for the standard eraser and two regular files for the die/eraser. When the child sees Heinz seeing the objects, she deploys a vicarious file indexed to Heinz for each of her own regular files. However, the vicarious eraser-file for the die/eraser is an error, since Heinz cannot tell by seeing that the object is an eraser. The erroneous file is therefore crossed out in the figure. The child has registered the information “also an eraser” on her regular die-file, and correctly does not transfer this information to the vicarious die-file (that the child correctly does not execute this transfer is indicated by the broken arrow). The anchors indicate the object a file is tracking.](image-url)
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