Working and Reflective Understandings of Sensory Modalities

Do we need to a distinction between working and reflective understanding in order to explain developmental discrepancies in children's understanding of sensory modalities? To demonstrate a need for such a distinction, we have to show that younger children don't understand the relation between sensory modalities and knowledge and also that they have competences which can only be explained by supposing that they do understand this relation.

1. The case for deficient understanding

O'Neill and Chong found that "many 3-year-olds appeared entirely unaware of how their own sensory actions were related to the property knowledge they had gained only seconds earlier … [C]hildren … responded … at times by demonstrating or naming an action that could not possibly have led to the knowledge in question" (O'Neill and Chong 2001: 812). Unlike 4-year-olds, they could not respond to an instruction to "[s]how me how you found out the bubble bath is strawberry bubble bath" (805) which only required them to repeat an action, and they could not respond to "[h]ow did you find out the bubblebath is strawberry bubble bath?" (805) either verbally or by demonstrating an action. Nor could 3-year-olds identify which sensory organ (mouth, eyes or hands) would be required to find out what the bubble bath is.

Is the problem that 3-year-olds do not remember how they experienced an object, whether they felt, saw or smelt it? This might seem plausible as subjects who understood the questions about their sources of knowledge could have answered them simply by recalling that they last smelt or felt an object. However, (Robinson and Whitcombe 2003: Experiment 2) demonstrate that children who fail these tasks can nevertheless remember whether they saw only part of an object or whether they saw a whole object. There is also some evidence that children observing two adults can recall which felt and which saw an object (Robinson and Whitcombe 2003: Experiment 1, video task). Accordingly, children's deficient understanding of sensory modalities cannot be straightforwardly explained by a failure of memory (O'Neill and Chong 2001: |813–4; Robinson and Whitcombe 2003: 58, 60–1).

A more promising idea is that children's difficulties understanding sensory modalities as sources of knowledge may be linked to a general failure to understand partial information (Robinson, Haigh and Pendle 2006 forthcoming). For example, in one paradigm children are told by an experimenter where a mouse is; in one condition, the utterance provides sufficient information to locate the mouse, in another it does not (for example, "the mouse is under one of the bowls"). Even 5-year-old children rarely ask questions about the location of the mouse when given insufficient information about its location, although 4- and 5- but not 3-year-olds do hesitate significantly longer before beginning to search for the mouse when given insufficient information (Plumert 1996). Similarly, 4- and 5-year-old children who are given a message consistent with two possibilities (for example, "I think it's the red one" when there are two red items) will rarely say that the message is defective (Robinson and Apperly 2001).[1] Accordingly, it is plausible that children genuinely do not understand how different sensory modalities can give rise to different types of knowledge about an

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[1]   [More references on this in (Robinson, Haigh and Pendle 2006 forthcoming: 3).]

object. They do not appear to understand that feeling an object can tell you whether it is hard or soft but not whether it is red or blue.

This deficit may be related to children's difficulties with the concept of knowledge. Robinson and Apperly (2001) suggest that children's difficulties with non-specific messages are related to difficulties with understanding that someone can have partial knowledge about an object (for example, can know that someone knows that an object is a ruler but not an eraser). Perhaps, then, children cannot imagine that someone could know what colour an object is but not whether it is hard or soft. In this case, inability to understand partial knowledge of objects would make it impossible for them to understand the significance of accessing an object by particular sensory modalities.

It is almost as if children think of knowledge of an object as an all-or-nothing state—either you know an object, in which case you know everything about it, or else you don't know the object at all—and that any kind of experiential contact with an object is sufficient for knowing it.

2. The case for understanding

There are two main sources of evidence that younger children do understand how experience in sensory modalities leads to knowledge. First (Robinson and Whitcombe 2003: Experiment 1) showed that children would accept an adults testimony only when the adult but not the child had knowledge-yielding sensory access to the object. In their experiment children were allowed to either see or feel an object before being asked what they thought it was. An experimenter then either saw or felt the object and then made a conflicting statement about what the object was. Finally, children were again asked what they thought the object was. Children changed their minds when only the experimenter should have been in a position to know given their sensory access to the object, but not when the child and the experimenter were both guessing. However, the authors suggest that the same children cannot say whether they know because they experienced the object or because they were told ("How did you know it was a strawberry/tomato—was it because you saw it or I told you?"), at least when this is not conflated with simply being able to recall what happened (Robinson and Whitcombe 2003: 58).

A second source of evidence for understanding comes from an experiment in which children were first given one mode of access to an object (seeing or feeling it) and then asked what it is at the same time as being given the opportunity to see or feel it (Robinson, Haigh and Pendle 2006 forthcoming). Here, even 3–4 year old children tended to see or feel the object only as necessary, demonstrating that they understood when further information was needed to answer the question and which sensory modality was required to obtain that information. Further support for this interpretation of the findings comes from the fact that children who had seen an object which could only be identified by touch would then choose to feel it rather than see more of it when given the choice (Robinson, Haigh and Pendle 2006 forthcoming: Experiment 3).

As well as revealing children's understanding of sensory modalities, these findings also show that children have some appreciation that it's possible to have experience of an object without knowing everything about it.

3. Working vs. reflective understanding

In short, the same children appear to both understand and not understand how sensory modalities lead to knowledge. This suggests that we may need a distinction between working and reflective understanding to explain the discrepancy in the experimental findings. This idea has already been endorsed, but it is an open question the distinction should be made:

> "At this stage we leave it vague as to what the labels *automatic, implicit, abstract,* and *reflective* might mean in terms of what knowledge is represented" (Robinson and Whitcombe 2003: 59).

> "Children's well-documented over-estimation of the knowledge to be gained from ambiguous or limited information was not in evidence. Our preferred explanation is that children's task of finding out which toy was in the tunnel tapped working understanding, rather than more reflective understanding demanded for success in typical tasks on children's handling of ambiguity" (Robinson, Haigh and Pendle 2006 forthcoming: 24).

> "their deficit is perhaps … an inability to become explicitly or declaratively aware of the source of perceptual experiences, perhaps as a result of an inability to process the source at the time of leaning the perceptual information" (O'Neill and Chong 2001: 814).

Intuitively a working–reflective distinction seems appropriate because the tasks children fail seem to involve some sort of reflection on how they know detached from any practical activity, whereas the tasks which they can pass seem to involve using information about sensory modalities in the course of doing something else (generally identifying an object). Accordingly, the discrepancy between success on intuitively practical tasks and failure on intuitively reflective tasks has suggested a comparison with children's discrepant performance on false belief tasks: information about false beliefs appears to be effective in controlling their eye movements, word learning and some deception-related behaviours (e.g. false denials) (Robinson, Haigh and Pendle 2006 forthcoming: 6; Robinson and Whitcombe 2003: 59).

Of course, applying a working–reflective distinction is not straightforward. If the distinction is to explain discrepant performance, we need answers to an array of questions including the following. The earlier questions are ones an adequate account of the working–reflective distinction should enable us to answer; the later questions are ones we answer in giving the account.

> What makes certain tasks tests of working understanding and what makes others tests of reflective understanding (Robinson, Haigh and Pendle 2006 forthcoming: 28)? In other words, we need to know what working understanding enables children to do and what reflective understanding enables them to do.

> Does reflective understanding supplant or supplement working understanding? For example, 'supplant' seems to be the correct answer for Goldin-Meadow's gesture–speech discrepancies in children's grasp of strategies for solving

mathematical problems (Goldin-Meadow 1999); the answer is also 'supplant' on Dienes and Perner (1999) and 'representational redescription' models. On the other hand, our working knowledge of syntax or faces is supplemented by reflective learning about syntax or the structure of faces. Similarly, where implicit or working understanding is used in explaining vision, it is usually supplemented rather than replaced by reflective understanding.

Acquisition: How are working and reflective understanding each acquired? Is working understanding supposed to be innate? Sometimes working understanding is supposed to be acquired by "abstraction of situational regularities", which seems implausible in this case (Robinson and Whitcombe 2003: 59)

Interaction in development: How if at all does having working understanding facilitate the acquisition of reflective understanding? For example, Goldin-Meadow (2001) suggests the following interaction: working understanding of a strategy for solving a mathematical problem causes children to gesture; their gestures are then read by adults as a signal that they are ready to learn a particular strategy; the adults then teach children the strategy, which provides them with reflective knowledge of it.

Online interaction: If reflective understanding does not supplant working understanding, both kinds of understanding are presumably available simultaneously and result in conflicting solutions to a single problem. How are working and reflective understanding coordinated? For example, Tony Dickinson (2000) suggests that associative learning systems and reasoning sometimes work independently on the same problem; convergence is generated not by any direct interaction between the two systems, but rather thus: the associative learning system has effects on the body which are consciously experienced as positive or negative (aversion), and these experiences inform what we desire. (This does not explain how associative learning results in judgements about causation, nor how top-down effects on associative learning are possible; as far as I know, Dickinson has no explanation of these.)

Action: How do working and reflective understanding contribute to purposive action? We know that children use their working understanding of sensory modalities in deciding which adults to believe and how to interact with an object (Robinson, Haigh and Pendle 2006 forthcoming: 28); this suggests that the distinction we need isn't the same as one that might be invoked to explain, e.g., the Paradox of Early Object Permanence where the discrepancy to be explained is between relatively involuntary eye movements or looking times and search behaviour. In the case of understanding sensory modalities, presumably younger children they can't form intentions whose contents directly involve sensory modalities but can only use information about sensory modalities indirectly. It would be useful to know what range of activities working understanding of sensory modalities is manifested in—whether there's an open-ended range of tasks, or whether it might be confined to using testimony and word learning (say).

Content: What are the contents of children's working and reflective understandings of sensory modalities? Some theorists have elaborated distinctions according to which exactly the same understanding may be implicit (i.e. working) or explicit understanding (e.g. Dienes and Perner 1999). Others have supposed that the concepts involved in working understanding are more

basic than those involved in reflective understanding, and that this difference in content contributes to explaining discrepant performance (e.g. Campbell 1992). I don't have any plausible suggestions to make (yet), but to illustrate with an implausible suggestion: younger children have a notion of experiential contact between a person and an object which is not differentiated by modality; they slowly learn that experiential contact does not always yield knowledge of an object, and observe that different types of action or body part are associated with success and failure without realising that these associations have any causal significance. Accordingly they don't understand the question "how do you know?" but they can predict in a limited range of cases when someone's experience provides knowledge of an object.

Process: Associations are acquired and modified by associative learning, whereas beliefs are acquired and modified by reasoning which is a different kind of process—one is automatic, does not rely on working memory, and is not directly subject to conscious control. Modular cognition (e.g. phoneme perception) appears similarly different from reasoning. Perhaps in making a distinction between working and reflective understanding we need to appeal to a difference in the kinds of process each involves.

I think 'content' is a good question to start with. This is complicated because we may not fully understand the content of adults' conception of sensory modalities and their relation to other psychological states. It's also complicated because there's a fine line between postulating a working–reflective distinction part of which is a distinction between two types of content, and simply attempting to explain discrepant performance by postulating partial understanding (as e.g. Wellman and Lagattuta 2000 does in the case of false belief). Ideally it would be possible to start with some quite general respect in which younger children's thinking might be limited and deduce from this some respects in which their concepts of sensory modalities and knowledge are limited. John Campbell attempted to do this for space and time by characterising working concepts as 'causally indexical':

"Often, one's grasp of the significance of … a judgement will be, in the first instance, a matter of how one reflectively expects the world to behave, and what counterfactuals one explicitly takes to be true In such cases, one's grasp of the judgement has to do with the detached picture one builds up of how things stand around one But there are cases in which one's grasp of the causal significance of a notion has to do not with any detached picture, but rather consists, in part, in one's practical grasp of its implications for one's own actions These are the causally indexical terms" (Campbell 1993: 82).

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	3 or 3–4 years	4 or 4–5 years	5 years	source
[source] "How did you find out the bubblebath is strawberry bubble bathy" (805)	no	yes on lenient score		
[source] "Show me how you found out the bubble bath is strawberry bubble bath" (805)	no	yes		(O'Neill and Chong 2001)
"You show me what Mr Potato Head needs to use to find out what the toys are"	no	yes		
children revise their judgements after testimony from a better-informed experimenter, but not when both the child and experimenter are guessing	yes			(Robinson and Whitcombe 2003)
Children correctly choose which of two adults' testimonies to believe on the basis of their information access (seeing vs. feeling)?	no	yes		(Robinson and Whitcombe 2003: Experiment 1)
"How do you know it's the red bug, because you saw/felt it or because I said so?" (conflates recall with source monitoring)	no	yes		(Robinson and Whitcombe 2003: Experiment 1)
[recall] "Did you see all of the strawberry/tomato or a bit of the strawberry/tomato?	yes	yes		(Robinson and Whitcombe 2003: Experiment 2)
[source] "How did you know it was a strawberry/tomato—was it because you saw it or I told you?"	no	no		(Robinson and Whitcombe 2003: Experiment 1)
Feel/see an object already seen/felt only when necessary to identify it? [partial access]	yes			(Robinson, Haigh and Pendle 2006 forthcoming: Experiment 1)
"Did you know it was the hard one because you saw it or because you felt it?"	no	yes		(Robinson, Haigh and Pendle 2006 forthcoming: Experiment 1)
Decide whether to it's necessary to see or feel an object before having any experience of it?	no	yes (harder than partial access)		(Robinson, Haigh and Pendle 2006 forthcoming: Experiment 2)
Decide whether it's necessary to feel an object rather than to see more of it?	yes			(Robinson, Haigh and Pendle 2006 forthcoming: Experiment 3)