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Emergence of Indicative Reasoning

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Synonyms

Discursive reasoning; Epistemic reasoning; Theoretical reasoning

Definition

Reasoning to determine what is true.

Introduction

Reasoning about what is true is referred to in philosophy as *theoretical* reasoning or *discursive* reasoning. It is also referred to as *epistemic* reasoning in developmental psychology, and *indicative* reasoning in psychological research that studies the way people reason about indicative statements. Indicative statements are simple assertions such as "*I am tall*," as opposed to statements that describe subjunctives such as "*If I were taller*" or include modals such as "*It **must** be raining.*"

Research has shown that development of the capacity to reason about truth is quite protracted compared to other types of reasoning. For example, toddlers use modals such as "*may*" to express permission ("You *may* do that") and "*must*" to express obligation ("You *must* do that"). Epistemic sentences use the same modals to express possibility ("You *may* be right") or necessity ("You *must* be the one who did it"), but these types of utterances do not reliably emerge in children's language until the 4th or 5th year of life (Ozturk and Papafragou 2015). It is not until this age that children also begin to reliably pass versions of theory of mind tasks that tap children's understanding of epistemic states such as true and false beliefs, and tasks that depend heavily on frontal lobe executive functions, such as switching rules by which objects must be sorted (Henning et al. 2011). Second-order mental state understanding (e.g., *Peter knows that Sally thinks it is raining*) does not emerge until about 6 years of age, and it undergoes steady development well into adolescence (Sullivan et al. 1994).

While reasoning about true and false beliefs in the social realm undergoes development, reasoning about truth and falsity on nonsocial tasks remains uniformly low throughout the lifespan. For example, 3 year olds perform poorly on reasoning tasks that require them to test the truth of indicative conditional rules. Cummins (1996a) showed 3- and 4-year-old children toy mice,

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some of which squeaked when squeezed. Children were told either "*The Queen Mouse says all the squeaky mice are in the house*" (epistemic) or *"The Queen Mouse says all the squeaky mice must stay in the house*" (deontic). They then had to choose whether to squeeze toy mice that were inside or outside of a toy house to "*make sure no one is disobeying the rule*" (deontic) or "*find out if she's wrong*" (epistemic). Across two experiments, two-thirds of 3-year-olds correctly chose to squeeze the mice that were outside the house in the deontic case, but only one-third chose to do so in the epistemic (truth-testing) case. Four-year-olds correctly chose the outside mice over 80 % of the time in the deontic condition, but performance on the truth-testing version remained unchanged at 33 %. Adults show the same magnitude differences on adult versions of deontic and truth-testing selection tasks (Cummins 1996b).

Similarly, Harris and Nuñez (1996) showed children cards that illustrated compliance with or violation of social rules such as "*When Julie rides a bicycle, Julie wears a helmet*." Children were required to find the picture that showed either that the sentence was wrong (epistemic) or that Julie was doing something wrong (deontic). Preschool children were found to perform nearly optimally on the deontic versions of the task but frequently made errors on the epistemic versions of the task.

Theoretical Explanations

Differences in learning opportunities. One explanation for deficient epistemic reasoning strategies relative to social reasoning strategies is that there is ample opportunity to induce schemas for reasoning about deontic situations given their ubiquity in the child's everyday experiences. Yet children are exposed to instances of lying (epistemic violations) as frequently as instances of misbehavior (prescriptive violations).

Despite this, we induce no efficient schemas for testing truth. Children and adults agree on what constitutes a violation of a social rule, but considerable disagreement exists among theorists concerning how the truth of statements should be tested. Moreover, both adults and children frequently employ deficient strategies (e.g., confirmation bias) when asked to test the truth of statements (see Cummins 1996b for a review). Moreover, normative theories of hypothesis-testing are relatively recent developments in the history of science (see Cummins 2012, chapter 7). The importance of adopting a falsification strategy was articulated as recently as the mid-twentieth century.

Differences in the complexity of metarepresentations and satisfaction conditions. Some researchers have argued that epistemic reasoning emerges later because it is more demanding of metarepresentational cognitive resources. But indicative sentences do not make use of modals, and hence are syntactically simpler than deontic sentences.

The same can be said about task complexity. Deontic and epistemic versions of reasoning tasks require children to detect discrepancies between a mental representation of what should be (e.g., "*Squeaky mice must stay/are in the house*") and the actual situation (e.g., "*Squeaky mice are not in the house*"). In both cases, the state of affairs described and the actual state of affairs must be compared in order to assess whether their satisfaction conditions have been met.

Evolutionary Explanation

Psychological investigations have repeatedly shown that adults and children perform better when evaluating compliance than when evaluating truth, and this difference has been replicated in dozens of experiments using a variety of experimental tasks over the course of 30 years (Cummins 1996b). Adults and children typically find the truth-testing version much more difficult than the deontic version of the task, even when the tasks require identical responses and even though they do not differ in representational or strategic complexity.

It should also be noted that while there is agreement among logicians concerning normative treatments of deontic conditionals, no consensus has been reached on how to capture the truth conditions of indicative conditionals (Edgington

2014). This suggests that it is something about our cognitive architecture that makes it easier for us to understand and process deontic tasks, a conjecture that is supported by two lines of evidence.

First, epistemic tasks appear to impose greater cognitive load than deontic tasks. Van Lier et al. (2013) found that performance on a nondeontic task declined when reasoners were burdened by performing a concomitant secondary task while deontic versions of the same task were unaffected.

Second, deductive reasoning typically activates a left-hemispheric frontoparietal network. Canessa et al. (2005) found that both deontic and truth-testing reasoning tasks activated this network. But deontic content also recruited activity in right hemisphere frontal and parietal regions, areas that play a major role in the processing of social content. The recruitment of this additional network apparently facilitates understanding and reasoning about social content.

Conclusion

Reasoning about truth depends on executive functions that are applied broadly across domains and develop slowly over the course of brain maturation and development. In contrast, deontic reasoning appears to benefit from specialized cognitive architecture that develops quite quickly in childhood to facilitate cognizing the social world.

Cross-References

- ▶ Abstract Logic Problem
- ▶ Cognitive Development
- ▶ Cognitive Science
- ▶ Development
- ▶ Developmental Evidence
- ▶ Emergence of Deontic Reasoning
- ▶ Judgement and Decision-Making
- ▶ Language Development
- ▶ Theory of Mind

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