6

Intuitive Epistemology: Children's Theory of Evidence

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Introduction

This chapter is premised upon a simple but potentially powerful assumption: it is not possible for the mind to acquire much of its knowledge without it also possessing an intuitive understanding of a set of epistemological concepts—namely, whatever concepts are just those which can be used by the mind to identify, in the stream of information that comes from the world, properties relevant to the formation of accurate belief. It is likely that extremely simple concepts of probability, causation, and testimony, along with the concepts needed to form very basic epistemic, statistical, and logical generalizations, are among the first members of the relevant set. Perhaps an elementary concept of knowledge is necessary too. But whatever the exact or initial membership of this set is, we believe that positing such a set is necessary to explain the fact that, even in young children, making inferences about the sorts of things which are relevant to accurate beliefs leads, often enough, to learning. Accordingly, we shall call the conceptual resources contained in this set, and which facilitate the formation of accurate belief, a learner's *intuitive epistemology*.

Our aim in this chapter is to develop support for a thesis that is a corollary of the view that the mind has an intuitive epistemology. We will argue that a learner's intuitive epistemology includes a *theory of evidence* by approximately the age of four. What this means is that the child has a grasp of enough epistemic concepts and interlinking principles to make, frequently enough, accurate judgments about what sorts of events, effects, and occurrences do and do not count as evidence. Additionally, we believe that the relevant concepts for evidence are not encoded or represented in the mind in an unstructured fashion—the concepts

for evidence are not more or less randomly distributed across (or among) the child's other concepts, prototheories, theories, and various other forms of mental representation. Our view, instead, is that the child's concepts of evidence are encoded as a *theory*, which means that the concepts are embedded within a web of inferential connections that hold, primarily, among the evidential concepts themselves, but also, secondarily, between the evidential concepts and a set of additional nonevidential concepts. The existence of the inferential structure linking the child's evidential concepts with one another is why it is appropriate to speak of a child possessing a *theory* of evidence.

A theory of mind defines a specific domain of knowledge: the conceptual content of a theory of mind demarcates what any individual can and cannot treat as a mental state. But a theory of evidence is not a domain-specific theory in that sense. Why? The epistemic concepts a theory of evidence contains can be employed when constructing various other domains of knowledge; for example, an unreliable informant can potentially mess up a child's intuitive physics or theory of mind or intuitive biology. The conceptual content of a theory of evidence therefore intersects with most other (perhaps *all* other) domains that are individuated by the nature of their conceptual content. So, since a theory of evidence cannot define a *sui generis* domain of knowledge, it is best thought of as a domain-general theory.

It is also likely that a theory of evidence, like domain-specific theories such as a child's theory of mind or of number, can be refined as a byproduct of the child's more basic capacity to make general, abstract, and causal inferences about the structure of her world (Gopnik and Meltzoff, 1997). At the same time, it is improbable that the conceptual content of a theory of evidence is constructed entirely as a byproduct of learning. Children are probably endowed with a handful of rudimentary concepts for evidence from the day that they are born. Here, the argument is familiar: it is hard to explain how a child could begin to construct knowledge of various domains without a grasp of at least some very simple epistemic concepts. These concepts, however, may be refined—or even completely reconstructed—as learning and development subsequently occur.

So, our conjecture is that young children may begin learning equipped with a small number of elementary epistemic concepts. Then, by constructing and evaluating beliefs about the world at different levels of generalizations and abstraction and in relation to different kinds and forms of evidence, children come to form both more refined concepts of evidence and also acquire specific principles which link their concepts of evidence with other concepts and

principles. In so doing, they begin to construct the earliest forms of their theory of evidence by constructing principles that link together their growing stock of concepts for evidence. Finally, after enough time, children seem to be capable of sophisticated reasoning about evidence in support of their learning—an observation which raises the interesting possibility that refining (and refining earlier refinements of) a theory of evidence is one of the ways a child learns to learn.

Here is how this chapter is organized. We will use the section titled "A theory of evidence: Theories support abstraction" to further clarify what it means to impute a theory of evidence to a young child. The section titled "Evidence of children's theory of evidence" then surveys some of the experimental evidence that we believe supports the existence of a psychological theory of evidence. Recent findings suggest that even very young children are surprisingly sensitive to different sources and types of evidence, and that this sensitivity informs their judgments in a way that is, frequently enough, conducive to the acquisition of knowledge.

Our focus changes in the section titled "Epistemologized psychology: Cognitive psychology as epistemology," where we pivot from a discussion of the empirical work which supports our contention that children have a theory of evidence to an examination of a new idea about how to implement the longstanding goal of naturalizing epistemology. It is surprising that, in light of the nearly overwhelming amount of philosophical scholarship on the question of how epistemology can be naturalized [cf. (Quine, 1969; Johnsen, 2005; Feldman, 2011)], one idea seems to be totally absent in the literature: that epistemology can be naturalized by *epistemologizing* cognitive psychology—where this means adopting as a working methodological idea the principle that normative concepts should be held to the same standard as nonnormative concepts throughout the formulation, testing, and acceptance or rejection of psychological theories. If a concept earns its place in a theory in the cognitive sciences by virtue of its ability to contribute to deep and oftentimes novel explanations, it should not matter whether that concept is (even a very thick) normative concept or not. Our view, then, is that such an *epistemologizing* of psychological methods will be among the effects of pursuing further research about either children's theory of evidence or, more generally, the mind's intuitive epistemology. It will be very hard to study how people learn about and use evidence without relying on deep commitments about what should and should not count as evidence—or, to put the same point another way, it

will be very hard to study how people learn about and use evidence without using many of the epistemological concepts we mentioned above in the first paragraph. We further explore some of the philosophical implications of the idea of an epistemologized developmental psychology in the section "Epistemologized psychology: Cognitive psychology as epistemology," before turning to concluding remarks in the final section "Conclusion."

A theory of evidence: Theories support abstraction

The word *theory* can be used as a technical term in psychology: theories are imputed to a person as constituents of their individual psychology to explain both the person's thinking and the impact of thought on their judgments and behavior. To return to an example from above, a theory of mind is meant to explain mindreading, which is the capacity in a person to predict and understand the mental states of others. What it means to impute a theory of mind, specifically, is to say that a person has conceptual representations of several abstract concepts and principles, and that this person can apply these representations to another's cognition in order to understand, predict, and otherwise interact intentionally with this other person.

It will be helpful to unpack this example a bit more. A theory of mind that is useful for making predictions about people's future behaviors and for coming up with explanations of their past behaviors must include, at the very least, concepts for desires, intentions, preferences, psychological causes, and beliefs. Furthermore, among the principles likely included in a minimally useful theory of mind are principles such as <if person P desires outcome X, P believes that doing Y will cause X, and P is in a position to do Y, then P will do Y>; <If P was observed doing Y, then P desired either Y or something else, Z, that was a direct causal effect of doing Y>; and <If person P is reaching her hand toward object O, it is because P wants O>. Crucially, these principles show how theories can create inferential connections between concepts that refer to observable things (an open hand) and concepts that refer to unobservable things (psychological desire)—so, these principles also provide a straightforward illustration of how one of the cognitive functions of theories is to confer the capacity to reason about things that are, either literally or metaphorically, beyond the limits of direct sensory detection. The usefulness of a theory can, therefore, be a function of the richness of the abstract concepts found within a theory and the capacity of

the theory to encode a meaningful number of inferential connections between those abstract concepts and concepts that refer to more concrete (observable, or easily perceptible) objects, kinds, and causes. Put more simply: theories are one way that we can make inferences about things, kinds, objects, processes, and properties that cannot be directly perceived.

We believe that the available experimental evidence suggests that it may be worthwhile exploring the hypothesis that children have a theory of evidence that is, in several important ways, analogous to their theory of mind. From birth, if not earlier, all children are the recipients of a constant stream of information from the world, their bodies, and the people around them. Only a small portion of this information is relevant to learning; much of this river of data can be discarded or ignored without any impairment to a child's subsequent learning. However, as we just noted, it is rarely if ever perceptually obvious which items of information are relevant to, or useful for, the formation of accurate belief; the world does not automatically place a label "this is pertinent to learning; treat this as evidence" on only the items of information that can facilitate the formation of accurate beliefs about the world. Classifying information as evidence requires abstraction, and abstraction can be facilitated by a mental theory. Accordingly, we suggest that one of the tools that learners use to selectively classify information that they are receiving from the world as evidence is a theory of evidence, because just such a theory can encode the principles which drive the ability to make inferential connections between perceptually salient effects, events, objects, and properties[1] and the members of a set of (abstract) concepts that each refer to different types, kinds, instances, and forms of evidence.

A theory of evidence: Theories link judgments with contexts and goals

But that is not all that mental theories do. A further reason why it is necessary to posit a *theory* of evidence, and not merely knowledge of an unstructured set of abstract concepts for evidence, is that what information counts as evidence for a learning depends upon at least two additional factors: the contexts in which different kinds of learning both are and are not possible, and the learning goals or outcomes that the child can possibly pursue.

The reason that a child must be able to reason about how context and goals interact with the judgments by which she classifies information as evidence is that no information counts as evidence in a categorical or absolute sense. For example, and to foreshadow our discussion of the scientific research which

supports our conjecture, the set of the kinds of evidence that can be used to learn the meaning of words has very little overlap with the set of the kinds evidence that can be used to learn the function of artifacts like hammers, balloons, or wheels—so, the learning goal (learning about words vs. learning about causal functions) places a constraint on the kinds of evidence that someone should be on the lookout for. Likewise, whether one and the same bit of information should be treated as evidence can vary from context to context. If a parent asserts that "that is a blicket" while idly daydreaming in the presence of a child who is playing in the same room but nowhere near the parent, the parent provides the child with no evidence whatsoever. But if, while at a science museum, a parent points at a brightly colored box that is adorned with flashing lights and, while making direct eye contact with a child, asserts "that is a blicket," then the child receives information that is appropriately classified as evidence. So, a child learning about blickets, for example, must understand that, in some contexts but not others, assertions about blickets can, and should, be treated as evidence.[2]

Importantly, the relationship between contexts, goals, and types of evidence is not fixed and unmalleable. As learning imbues the mind with increasingly complex knowledge structures, the relationship between evidence, goals, and context can change dramatically. A person who learns, for instance, some of the rules of deductive logic thereby learns principles that can, inter alia, be used to classify mutually exclusive events as a type of evidence, a development which dramatically increases the number of contexts in which causal learning can occur. Likewise, someone who learns about the character trait of honesty learns about a kind of evidence that also expands the number of learning goals a learner can work toward achieving—as testimony is one of the most powerful drivers of learning (Tomasello, 2014; Lackey, 2008; Stephens and Koenig, 2015; Koenig and Harris, 2007; Koenig, Clément, and Harris, 2004). What's more, learning about honesty also expands the number of contexts in which interpersonal learning both can and cannot occur.

Thus, a person's theory of evidence can be thought of as the conceptual tools they use to make judgments both about *what* information counts as evidence (this requires abstraction) as well as *where* and *when* a learner should and should not be looking out for the kinds of evidence that she knows about (this requires knowledge of learning goals and contexts). Or, to put these ideas even more explicitly, our hypothesis is that a theory of evidence includes

(a) A set of abstract concepts, which probably includes simple concepts of probability, causation, and testimony, along with the concepts needed

to form very basic epistemic, statistical, and logical principles and generalizations;
(b) Inferential principles connecting the concepts of evidence with other nonabstract concepts;
(c) Inferential principles connecting concepts of evidence with concepts referring to different types of learning contexts and different types of learning goals—for example, learning from adults versus learning from one's peers, learning about the meanings of words versus learning about the rules of the game, and so on.

It is our view that very simple concepts of evidence, learning goals, and contexts populate the mind's earliest instantiations of a theory of evidence. But because a theory of evidence is itself a byproduct of learning, it is entirely possible—and, as the examples we used above suggest, we believe quite likely—that a person's theory of evidence undergoes substantial increases in its richness and complexity over the course of their own cognitive development.

Evidence of children's theory of evidence

That said, our focus in this chapter is only the theory of evidence as it likely exists in the minds of children at about the age of four. And, the scientific argument that children rely upon a theory of evidence in order to acquire some of their knowledge is straightforward. If children have a theory of evidence roughly as we have defined it above, then, on abductive grounds, we should observe children

1. Making judgments in which they treat different kinds of information *as if* it is evidence; and where
2. These judgments are usually *context* and *goal* appropriate; and where, partially because of this,
3. The information that is treated *as if* it is evidence is information that *should be* treated as evidence; and where, because of (1), (2), and (3),
4. The judgments are usually supportive of learning.

We will now describe five cognitive abilities that children use to facilitate their learning, each of which looks like it satisfies our quadripartite prediction. There are more examples in the literature which also fit our prediction—however, the following are the clearest examples that we know of, and by limiting ourselves

to a discussion of just the following five capacities, we can keep this chapter reasonably focused.

Accuracy monitoring

As a rule of thumb, any indication that some information is accurate is indication that the information is *potentially* evidence. Consistent with this idea, recent work using studies of how children learn from the people they are interacting with has shown that children rely on a number of proxies for accuracy of information. Perhaps the simplest example of this occurs when a prior history of accuracy in labeling objects that the child is familiar with is taken by the child to mean that the person doing the labeling is a reliable speaker. Children then project this estimation of reliability by trusting new labels introduced by the same person for both novel words and novel object functions (Birch, Vauthier, and Bloom, 2008; Koenig and Harris, 2005). Children are vigilant monitors of the content of people's speech to them, checking what they are hearing for consistency and conflict, but they also monitor and track variations in speakers' moral behavior, mutual consensus, and group membership (Hetherington, Hendrickson, and Koenig, 2014; Mascaro and Sperber, 2009; Corriveau, Fusaro, and Harris, 2009)—these are all properties that can be reliably interpreted by learners as "proxies" for accuracy, even though each differs in how complex the association between accuracy and the proxy is likely to most frequently be. Indeed, by age four, children can monitor the probability of accuracy; they are able to decide how likely someone is being reliable, as opposed to making simple deterministic "yes/no" judgments of a person's reliability (Pasquini et al., 2007). Children are also more likely to trust speakers who are members of their linguistic community—as evidenced by, for instance, speaking with the same or a familiar accent (Kinzler, Corriveau, and Harris, 2011). Since children must learn many of the finer details of the local social worlds that they inhabit, and since these social worlds are constructed, in part, by the linguistic practices of their inhabitants, it is rational to accord speakers who are members of the same linguistic community a higher degree of trust. Finally, we can see how some of the complexity of children's theory of evidence by looking at studies which require children to compare two different potentially accurate sources of evidence. Children frequently use age (adults vs. other children) as a proxy for accuracy, but this can be overridden by independent observations of specific instances of accuracy or reliability,

such as when a young child knows more than an adult about, for instance, a character in a story or a movie (Jaswal and Neely, 2006).

Recognizing knowledge and distinguishing between knowledge and ignorance

But children do not only rely upon a variety of proxies for accuracy—they are also able to reason, much more directly, about knowledge and ignorance. Of course, one person's knowledge should be another person's evidence. In line with this principle, and even from very early in development, children are able to distinguish between people, including themselves, according to knowledgeability. At the age of twelve months, infants have been shown to point more to the location of an object when they see an adult who is ignorant of the object's location looking for the object, compared with an adult who has knowledge of the object's precise location (Behne et al., 2012; Liszkowski, Carpenter, and Tomasello, 2008; O'Neill, 1996). By the age of sixteen months, infants use pointing gestures as interrogative demands—in order to elicit information—but only from people who are knowledgeable of the relevant information (Begus and Southgate, 2012; Southgate, van Maanen, and Csibra, 2007).

It is therefore hardly a surprise that, by the age of two, children can offer verbal reports of their own knowledge and ignorance, calibrate these reports in degrees of certainty, and modulate or refine these reports in light of self-observation (Shatz, Wellman, and Silber, 1983; Furrow et al., 1992); or that, by the age of three, children are able to accept or reject claims that are, by an independent baseline, highly reliable. For example, children may choose to reject claims made when a speaker asserts their own ignorance or uncertainty about a specific claim that they have made; for example, "Hmm, I don't really know what this is but I think it is a blicket" (Sabbagh and Baldwin, 2001; Sabbagh and Shafman, 2009; Henderson and Sabbagh, 2010). And finally, in studies that ask children to interact with two informants who differ consistently in the knowledge that they profess to have, children display, systematically, a preference for agreeing with the informants who seem to have more knowledge over informants who profess their own ignorance, and over informants who make incorrect guesses but make their uncertainty clear, for example, "Hmm, I'm not sure. I'll guess it's read" (Mills et al., 2011). Children also make proactive choices based on their estimates of knowledgeability; by age three, children will direct more questions to knowledgeable people than people who are ignorant, and by age five, children

will direct more questions to a knowledgeable person than a person who makes plausible but inaccurate guesses (Mills et al., 2011).

Causal learning is also influenced by children's ability to conceptualize their world as containing people who have varying degrees of knowledge. In a recent study, children were presented with one of two variables: whether a potential informant was knowledgeable or ignorant about a novel toy, and also whether the informant was permitted to use that knowledge in performing an action. Then, children observed, in all of the conditions in this study, the two informants performing identical causal actions—and where, importantly, the actions themselves were unconstrained, equally intentional, and equally strongly associated with the effect that they produced. Children were more likely to attribute causal efficacy to the informants who were knowledgeable than to those who were not, suggesting that estimates of causal efficacy depend, even at a very young age, on accurate judgments about knowledge possession (Kushnir, Wellman, and Gelman, 2008). Furthermore, a similar study shows that an informant's statement about knowledge or ignorance about the causal properties of a toy influence whether preschool-aged children will imitate the informant's actions faithfully or not (Buchsbaum et al., 2011).

Assessing relative expertise

Children can reliably distinguish between knowledge and ignorance. But they can also make reasonably sophisticated estimates of relative expertise—such as when they compare the accuracy of the knowledge of two otherwise knowledgeable, or at least not obviously ignorant, informants.

The simplest example of this comes from the various studies showing that, by about the age of four, children know that different people know different things (Lutz and Keil, 2002; Danovitch and Keil, 2004). For example, mechanics are more likely to help with fixing bikes, whereas biologists know more about bird migration. (Something like that.) But children are also able to make projective inferences about what (additional) knowledge a person is likely possess on the basis of learning about some of the knowledge the person has. Children were introduced to one person who knew when objects would activate a special machine in a certain way and another person who knew when objects would activate the machine in another way (Sobel and Corriveau, 2010). Children were then shown objects that possess one of these different causal properties and were asked to endorse one of the confederates' novel labels for the objects.

In a similar study, preschoolers were introduced to two informants, one of whom (the "labeler") properly named two tools but failed at fixing two broken tools, and the other of whom (the "fixer") did not know the name for the tools but was able to fix the broken toys (Kushnir, Wellman, and Gelman, 2013). Both three- and four-year-olds selectively directed requests for new labels to the labeler and directed requests that a toy be fixed to the fixer. Then, in a second experiment in this study, four-year-olds also endorsed the fixer's causal explanations for the toy's mechanical failures, but not also the fixer's new names for objects. Together, these findings suggest that young children are able to represent both the scope and limit of other people's expertise.

Estimations of the relevancy of information to learning

Related to these judgments about the expertise of potential informants, children are also able to make sound inferences about whether or not novel information is relevant to the learning at hand. Evidence of this comes from studies of preschoolers that examine how pedagogical (or "ostensive") cues such as eye contact, child-directed speech, and generic language might provide a signal to children that information is being "taught" to them, and also for some epistemically meaningful purpose. For instance, children generalize further (Butler and Markman, 2012), imitate more faithfully (Southgate, van Maanen, and Csibra, 2009; Brugger et al., 2007), and restrict exploration (Bonawitz et al., 2011) as an effect of observing actions that are pedagogically demonstrated.

Relevancy is perhaps the simplest way of assessing whether novel information should be treated as evidence; these studies, therefore, suggest that children have a useful concept, albeit simple, for one type evidence by the age of four. But furthermore, one explanation for why pedagogical demonstrations have an impact on children's reasoning is that they invite children to make inferences about the social or cultural relevance of actions (Moll and Tomasello, 2007; Southgate, van Maanen, and Csibra, 2009). If this is right, then the estimates of relevancy produced by interactions between by a child's theory of evidence and external pedagogical cues are not only assessments of mechanical or causal relevance; they are also assessments by which a child can come to learn important facts about how her social worlds can facilitate learning. In light of this, it has been suggested that these interactions are a key driver of some of the impressive patterns of cultural learning that seem to be proprietary to our species (Csibra and Gergely, 2009, 2011).

Pedagogical cues have also been shown to support learning about both abstract categorization and object function. Several studies have demonstrated that children use pedagogical cues as an indication of which features of an object can be used to determine the object's correct categorization. The general method used throughout this work is one in which surface features of objects (such as color and shape) and nonobvious features (such as internal structure of causal powers that become apparent only after interactions with the object) are used to generate conflicting categorization judgments. When deciding between trusting categorizations based on surface features versus categorizations based on nonobvious features, preschoolers will, all things being equal, prefer the surface feature categorizations. However, after receiving particular pedagogical demonstrations of categorizations based upon nonobvious features, children are more likely to follow suit and use nonobvious features as the basis for their categorization judgments (Williamson, Jaswal, and Meltzoff, 2010; Butler and Markman, 2014; Yu and Kushnir, 2015). Of particular importance is the observation, in the last of these studies (Yu and Kushnir, 2015), that children show an equal interest in exploring the nonobvious features of objects whenever they are demonstrated—it is always fun to play with objects that make interesting sounds. Nevertheless, children in this study did distinguish between cases where nonobvious features are relevant to categorization and when they are not. Children's understanding of evidence for categorization, then, extends beyond their ability to distinguish between surface and nonobvious features.

In short, children are able to distinguish between when properties are relevant to learning and when they are not. Frequently, pedagogical cues assist them with this task; we are not claiming that a theory of evidence itself is sufficient to produce most forms of learning that are possible by the age of five. Rather, and again, the suggestion is that these cues interact with elements of a child's theory of evidence. The child's theory of evidence tells her that she is in a pedagogical context and that certain verbal cues are a source of evidence, while the cue itself provides the content of the evidence and may even, over time, lead to an enrichment of the theory of evidence itself so as to include concepts for the types of evidence that, earlier on, were the focus of pedagogical interactions.

Early attention to source of information

Finally, some indirect evidence of a theory of evidence comes from a cognitive ability that may precede the development of a psychological theory—the ability

to simply scan and filter the near environment for information that can be treated as evidence. The existence of a capacity for what might be called *selective* evidential filtering is suggested by work showing that infants can ignore certain features of perceptual input and focus on the parts that are potentially relevant for making inferences based on probability (Denison and Xu, 2010, 2012; Xu and Denison, 2009).

To be clear, selective evidential filtering is not an example of an ability that seems well explained only by positing a theory of evidence. It is important to distinguish between making principled inferences about information that may or may not count as evidence, and, more simply, being able to attend to sources of information that could potentially be evidence. A theory of evidence is necessary to explain the former, while possession of a handful of mostly unconnected evidential concepts can account for the later. Nevertheless, evidence of selective evidential filtering is indirect evidence of a child's theory of evidence, simply because it would be very surprising if children made the leap from possessing no concepts of evidence whatsoever to possessing a network (i.e., a theory) of concepts of evidence and principles governing the use of those concepts in reasoning. What is more plausible is that there is an intermediary developmental stage, in which infants or very young children have and are able use concepts of evidence but do so only in ways that do not suggest that these concepts drive much in the way of deep inferences.

Still, it would be a mistake to think that all of children's ability to reason about evidence can be explained without postulating a *theory* of evidence. This is demonstrated by a recent study in which four-year-old children were given identical data that could help them learn words that functioned as simple labels for novel objects (Xu and Tenenbaum, 2007). Crucially, the data differed only in its source—whether it come from a knowledgeable teacher or the learner themselves. The children in this study learned the labels more accurately when this information was acquired from the teacher, seemingly indicating that, by about the age of four, children can integrate information about context with their judgments about evidence.

Epistemologized psychology: Cognitive psychology as epistemology

Stepping back now, what these studies show is that children can make rational inferences about evidence. Again, we suggest that a psychological theory of evidence is an attractive scientific explanation of children's ability to do this.

But the fact that a theory of evidence is itself a scientifically plausible explanation of some aspects of human cognition generates a further, and apparently novel, philosophical implication about what it means to naturalize epistemology. The conclusion we have just arrived at raises the intriguing possibility that experimental epistemology may be a subfield of cognitive psychology—that is, the subfield of cognitive psychology that employs intrinsically normative, intrinsically epistemological concepts and principles to study the epistemically relevant psychologically phenomena, such as learning, perception, memory, and testimony. Put another way, the fact that the hypothesis that children's rational learning may be facilitated by a theory of evidence is scientifically plausible provides us with further reason to think that it may be possible to naturalize epistemology by *epistemologizing* psychology.

Allow us to explain. First of all, it is important to stress that the idea of epistemologizing psychology is not the same idea as the frequently mooted Quinean dictum that epistemology can be naturalized by replacing it with a branch of psychology (Quine, 1969). As Quine's dictum is probably most frequently interpreted, it is taken to mean that an existing body of scientific research spanning psychophysics to cognitive psychology will be able to answer most of the traditional questions in epistemology—and, in so doing, this research will render the existing field of epistemology redundant. Yet, there is an ambiguity in the Quinean dictum that is easy to overlook if the dictum is understood at only this level of abstraction. The dictum, specifically, does not address the psychological/causal question of how much *rationality* is required to induce meaningful learning (Putnam, 1982, pp. 20–21). In the abstract, Quine's dictum is compatible with the proposition that the mind produces accurate beliefs by a series of entirely mechanical transformations performed on the information derived from the sensory transduction, with no normative or computational processing required at any point along the chain from sensation to belief. But an alternative view is that both normative and computational processing is necessary for the mind to construct a deep and rich network of mostly accurate beliefs on the basis of sensory experience—it is not possible to learn about the world without reasoning about it, and it is not possible to reason about the world without recruiting or implicating some normative concepts to the computational processes that constitute such reasoning. If the latter is the case, then it will not be possible for psychology to study how accurate beliefs are formed without embedding any number of intrinsically normative concepts in the formulation of (even just empirically adequate) psychological theories—because these concepts must be used in order for the relevant theories to be able to describe *how* it is that the mind does what, rationally speaking,

it *should* do. And, since Quine published his famous article, one of the most significant historical lessons of almost four decades of research in cognitive science is that an *immense* amount of processing is required in order to turn sensory information into accurate belief (Johnson-Laird, 1988; Tenenbaum et al., 2011; Xu and Kushnir, 2013; Marr, 1982). As indicated, this fact means that scientific explanations of how reasoning facilitates the acquisition of accurate beliefs will depend upon the injection into psychological theories and methods of any number of (intrinsically normative) epistemic concepts—or, to put this conclusion another way, in order to discover, scientifically speaking, how accurate beliefs are formed, cognitive psychology must, to some important degree, be epistemologized.

There is a different path to the exactly the same conclusion. It is often asserted, though much less frequently argued, that the deepest methodological difference between philosophy and science is that philosophy is about either purely conceptual matters or purely normative matters, while science concerns itself almost exclusively with descriptive matters of empirical fact [cf. (Longino, 1996)]. Yet, if this pair of ideas were adopted as part of the methodological framework used by a cognitive scientist or a philosopher interested in studying the functional role that a theory of evidence plays in learning, the ideas would work together to block any scientific research. This is because one cannot formulate causal-explanatory hypotheses about the cognitive function of a psychological theory of evidence—or, more generally, an intuitive epistemology, or even knowledge of general statistical and logical principles—without making two kinds of commitments.

The first are commitments about what kinds of concepts the mind needs in order to be able learn by reasoning about such things as which should count as evidence. Since at least some, and probably most, of these concepts will be epistemological concepts and will thus be inherently normative concepts, there will be no way to formulate hypotheses meant to explain learning without making commitments that, at minimum, amount to the position that the minds of learners frequently use intrinsically normative concepts and that they, at least almost as frequently, use those normative concepts in the way that those concepts *should be* used.

The second commitment is more abstract. It is a commitment that comes in the form of methodological openness to the possibility that, as research into such topics as the mind's intuitive epistemology progresses, novel *sui generis* epistemological conclusions may emerge as byproducts of ordinary scientific inquiry [cf. (Xu, 2007, 2011; Fedyk and Xu, 2017)]. For example, in related

work, we have argued that learners have *prima facie* right to the exercise of a complex ability that we call "cognitive agency" (Fedyk and Xu, 2017). But, obviously, to commit oneself to the proposition that science can make progress toward answering descriptive questions only is to deny this very possibility. So, the fact that a theory of evidence is a scientifically plausible hypothesis in developmental psychology shows, working backward through these inferences, that it would be a mistake to hold that there is methodological dissociation between philosophy and science such that philosophy is about conceptual or normative matters *only* and science about descriptive or empirical matters *only*. As research on children's theory of evidence demonstrates, progress in psychology science can sometimes depend essentially upon the normative content of its causal-explanatory theories.

These two lines of reasoning, thus, each lead us to exactly same conclusion—namely, that it can be inductively and explanatorily fruitful in cognitive psychology to use intrinsically normative-epistemological concepts, assumptions, hypotheses, and principles. By this, we do not just mean that sometimes it will be scientifically fruitful to use a particular normative concept in a (purely?) descriptive way—such as to simply characterize the content of someone's mental states. We mean, in addition to this, that, often enough, it may be scientifically fruitful to formulate psychological theories that are themselves normative; they describe some aspect of the cognitive system while also saying what cognitive systems should (or should not) do. And so, what the proposal that psychology be epistemologized amounts to is that we take up this latter reading of our conclusion and run with it as far as the science will allow. Pursuing an increase in the normative-epistemological content of psychology as far as the data will take us is what it means, methodologically speaking, to epistemologize psychology.

To return briefly to an idea broached a few paragraphs back, the coherence of epistemologized psychology shows that it is a mistake to hold the view that naturalizing epistemology must consist of a search for analytical concepts that can reduce epistemology to some pre-existing research somewhere in the behavioral sciences—or even just searching the natural sciences for concepts and principles that seem like they can help resolve classical problems in epistemology, like the definition of knowledge (Kornblith, 2002). Instead, the most productive and integrative way to naturalize epistemology could be to work how to *elevate* research in psychology to the status of epistemology.

Furthermore, the coherence of epistemologized psychology also demonstrates that experimental epistemology may simply be contemporary cognitive

psychology, albeit only after the latter is imbued with sufficient normative concepts and principles, and the latter also begins to operate from a set of methodological norms expanded to create the space to pursue scientific answers to questions like "How should I reason?" "When should I stop searching for new knowledge?" and "Which of my beliefs are most trustworthy?" Of course, there is no guarantee that the epistemological concepts which carry the most inductive or explanatory weight in even minimally epistemologized psychology will also be the highly refined, mostly technical concepts that are central to debates in contemporary analytic epistemology. This means that the conceptual content of epistemologized psychology should not be assumed *a priori* to have substantial overlap with the conceptual content of contemporary analytic epistemology. Likewise, epistemologized psychology need not, and probably should not, have among its methodological ends the goal of determining whether or not the intuitions that philosophers treat as evidence are widely shared among people who are not professional philosophers (Stich, 2018; Machery et al., 2015; Nado, 2016; Weinberg, 2015); though it is essentially experimental, epistemologized psychology is not *that* kind of experimental epistemology. But at the same time, it is not unreasonable to predict that there may be some areas of conceptual overlap between empirically adequate theories in epistemologized psychology and the conceptual content of certain popular theories in analytic epistemology—since, after all, some of the best of these theories represent efforts to *psychologize* analytic epistemology (Sosa, 2017; Goldman, 2002).

Conclusion

We believe, thus, that the hypothesis that the mind constructs a theory of evidence early in life represents an intriguing area for future research in epistemologized psychology. Indeed, we think that more systematic efforts to understand the conceptual resources and inferential structure of the mind's intuitive epistemology represent an even richer area of future research. The payoff, philosophically speaking, for carrying out either of these research programs is that the success of either would contribute to the further naturalization of epistemology by way of increasing the epistemologization of psychology. Indeed, it is not impossible that epistemologized psychology may eventually be able to answer questions such as "What epistemological concepts and principles do people have, in virtue of which they are able to learn?" "How does a theory of evidence develop over time?" "What elements of the

mind's intuitive epistemology are most conducive to learning?" "What forms of rationality are possible for the human mind?" and so on.

The upshot, therefore, to further epistemologizing psychology is that we may eventually arrive at compelling answers to very deep questions about the mind, belief, and knowledge—and where these answers do not differ in their respective degrees of scientific and philosophical plausibility.

Notes

1 In fact, this is an oversimplification. Many of things that count as evidence cannot be classified correctly as the thing that they are based on observation alone. Instead, many of the things that a learner can learn to use as evidence can only be accurately classified using any number of independent psychological theories or abstract concepts. For example, word learning depends a theory of language, or at least a minimally useful semantic theory. So, a more precise formulation of our hypothesis is that a separate theory of evidence is needed to explain what other domain-specific psychological theories cannot—viz., children's ability to identify what things are appropriately classified as evidence but nevertheless fall within the scope of the other theories that they know. The point here in this footnote is to clarify that sometimes—perhaps all the time—this may involve abstracting over an abstraction.

2 Thus, one of the crucial functions that a child's theory of evidence is that it allows her to determine what information is and is not epistemically relevant to her learning. This is not an easy problem to solve. But it is an easier problem than a related and, to epistemologists, much more familiar problem. Recent work in philosophical epistemology has examined how the ability to determine if a piece of information (a fact, a proposition, etc.) is or is not epistemically relevant can help answer the Cartesian sceptic and thus underwrite a very strong conception of knowledge. Indeed, some well-known examples in the literature hold that learning—if learning produces knowledge—requires a knower be able to eliminate *all* relevant alternatives, and so requires of learners the underlying psychological ability to determine all possible relevant criteria. For example, David Lewis proposed that seven independent principles can be used to determine whether information is epistemically relevant or irrelevant—and being able to use these criteria involve, inter alia, making judgments about the reliability of abductive methods and the scope of established conventions for ignoring past knowledge (Lewis, 1996). Perhaps using Lewis' principles are some of what is required to construct a theory of knowledge that can resist a Cartesian skeptical. But as a matter of psychological plausibility, we think it is much too demanding to impute the capacity to use most

Lewis' principles to young children. So, the epistemologist's problem of relevance is not the same problem of relevance that we believe a theory of evidence purports to solve. Instead, our problem is to explain how the learning process starts, which, again, is not to be confused with the problem of constructing a form of knowledge that is immune to Cartesian skepticism.

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