unexpectedly asked to do so. Zentall trained pigeons to report the location that they had just pecked. They were then trained on a conditional discrimination task to associate different colored samples with differently oriented comparisons (e.g., a blue key with a key with horizontal lines). Once they had learnt this task, the pigeons would suddenly after a 2 s delay at the end of a trial be presented with the cue to report which key they had just pecked. Zentall argues that the pigeons must have used episodic memory to answer this question because they had no opportunity to acquire semantic or rule-based memory. Critics have suggested that given the short timescale over which these experiments operated the use of working memory cannot be excluded but the use of working memory does not necessarily exclude episodic components (Zentall et al. 2008).

Research to date has been on a small number of birds in very few species. While some birds can clearly act on specific past events, it remains an open question as to the precise cognitive processes that enable this behavior and in particular whether birds consciously recall a past event that they have experienced.

Cross-References

► Planning in Birds

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Epistemic Beliefs

► Beliefs About Learning

Epistemic Curiosity

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Synonyms

Cognitive curiosity; Intellectual curiosity; Scientific curiosity

Definition

Epistemic curiosity is the desire to obtain new knowledge (e.g., concepts, ideas, and facts) expected to stimulate intellectual interest (I-type) or eliminate conditions of informational deprivation (D-type). I-type epistemic curiosity appears to be maximally activated when individuals recognize opportunities to discover something completely new, whereas D-type epistemic curiosity is optimally stimulated when people lack specific pieces of information they wish to incorporate into an existing knowledge-set. Once activated, the degree to which each type of epistemic curiosity is experienced and behaviorally expressed has been found to vary according to individual differences in I- and D-type epistemic curiosity personality traits (Litman 2008).

I- and D-type epistemic curiosity each corresponds to different orientations toward seeking new information. I-type epistemic curiosity involves focusing on the inherent enjoyment of new discoveries, and motivates broadly seeking new information in order to stimulate positive affect. D-type epistemic curiosity reflects an unsatisfied need-like state that motivates seeking knowledge capable of reducing undesirable states of uncertainty about specific unknowns. D-type epistemic curiosity appears to be a stronger motive for knowledge seeking than I-type epistemic curiosity, and is associated with higher levels of state-curiosity and a greater degree of subsequent information seeking behavior as compared to I-type epistemic curiosity (Litman et al. 2005).

I-type epistemic curiosity is a purely intrinsic motive to obtain new knowledge, whereas D-type epistemic curiosity may be conceptualized as an "integrated" motive that involves both the intrinsic pleasure of learning as well as extrinsically regulated concerns about the accuracy or fit of newly gathered information

(Litman 2008). In academic settings, I-type epistemic curiosity is associated with developing mastery-oriented learning goals, the achievement of which leads to increased interest and engagement (Litman 2008). D-type epistemic curiosity is also involved in mastery-oriented learning, but is more strongly associated with setting performance-oriented learning goals, for which the correctness and relevance of newly acquired knowledge is critical to goal achievement. In the workplace, I-type epistemic curiosity is associated with being motivated to develop new skills, whereas D-type epistemic curiosity motivates identifying and solving specific problems (Litman et al. 2010).

Theoretical Background

The concept of epistemic curiosity as an emotional-motivational state was first explored by Berlyne (1954), who viewed this construct as a uniquely human desire to know aroused by novel questions or complex ideas that pointed to gaps in one's knowledge. According to Berlyne, epistemic curiosity motivated exploration aimed at the acquisition of new knowledge through observation, thinking, and asking questions. He explicitly differentiated between epistemic curiosity, which motivated the pursuit of knowledge, and seeking stimulation from sensations and perceptions, which he considered to be a common motive of both animals and humans.

Day (1971) later expanded on Berlyne's work, and theorized that epistemic (as well as sensory-perceptual) curiosity corresponded to states of situational interest influenced by individual differences in intrinsic motivation as an aspect of personality. In keeping with Berlyne's theories of epistemic exploration, Day developed measures to assess dispositional tendencies to take pleasure in seeking out both specific and diverse forms of novel or complex stimulation.

Consistent with Berlyne, Loewenstein (1994) also hypothesized that epistemic curiosity was aroused by specific gaps in one's knowledge. He proposed that the degree to which epistemic curiosity was activated depended directly upon an individual's metacognitive awareness of the extent to which he or she had relevant knowledge stored in memory. However, Loewenstein differed with Day's view that epistemic curiosity involved pleasurable states of intrinsic interest, and theorized that subjective experiences of epistemic curiosity primarily reflected uncomfortable states of informational deprivation. According to Loewenstein, seeking out new knowledge is motivated more by "the aversiveness of not possessing the information more than it is by the anticipation of pleasure from obtaining it" (1994, p. 92).

Litman and colleagues reconciled these different views on the nature of epistemic curiosity by examining the circumstances where epistemic curiosity is pure intrinsic motivation and involves feelings of interest (I-type), and when it is oriented toward the elimination of unpleasant conditions of informational deprivation (D-type), and therefore also involves extrinsically regulated concerns about the accuracy and relevance of newly gathered information. Recently, Litman and colleagues developed brief, reliable psychometric instruments for assessing individual differences in the experience and expression of I- and D-type epistemic curiosity (Litman 2008; Litman et al. 2010) that measure tendencies to enjoy learning something completely new (I-type epistemic curiosity scale) as well as the frequency that one feels bothered by a lack of information (D-type epistemic curiosity scale).

Using the I/D epistemic curiosity scales, Litman, Russon and Hutchins (2005) found that I-type epistemic curiosity appears to be maximally aroused when individuals metacognitively determine they have little or no prior knowledge relevant to the information they seek, whereas D-type epistemic curiosity is optimally aroused when individuals feel they have some relevant information already in memory. This suggests that the recognition of knowledge-gaps, as well as the nature and magnitude of the gap, determines whether epistemic curiosity is experienced as feelings of pleasure (I-type) or displeasure (D-type), with the latter found to be a stronger motive to seek out knowledge.

Important Scientific Research and Open Questions

Several important questions remain regarding the nature of epistemic curiosity, both in terms of its measurement as personality trait and the arousal and satiation of epistemic curiosity as an emotional-motivational state.

The Measurement of Individual Differences in Epistemic Curiosity as a Personality Trait

Individual differences in epistemic curiosity are assessed by Litman's (2008) 10-item I/D Epistemic

Curiosity Scale, which comprises five-item I-type and D-type measures. Although each scale is found to be internally consistent, define different factors and have different correlates, this line of research is relatively new, and further study is needed to elucidate the thoughts, feelings, and behaviors associated with dispositional tendencies to experience and express I- and D-type epistemic curiosity. Accordingly, the degree to which these measures of epistemic curiosity can be meaningfully differentiated from related constructs such as Need for Cognition or Openness requires further investigation (Mussel 2010).

Metacognition and the Arousal of Epistemic Curiosity

The arousal of I-and D-type epistemic curiosity appears to be associated with different metacognitive states (Litman et al. 2005). However, further research is needed to elucidate why unpleasant feelings are associated with epistemic curiosity when individuals believe they have some prior knowledge in memory; more research is also needed to clarify why state-curiosity is more intense under these circumstances. Loewenstein (1994) suggested that curiosity may intensify when we feel closer to completing a knowledge gap because of learning processes involved in goal attainment; that is, motivation tends to increase in strength as we approach satisfaction of an appetite. Possibly, similar mechanisms underlie self-directed knowledge attainment as well. Another possibility is that the reward-value of new information depends in part on its ability to be incorporated into existing knowledge-sets. These intriguing possibilities need to be explored in future research.

The Satiation of Epistemic Curiosity, Learning, and Experiences of Reward

On the basis of observable behavior and the self-reported intensity of associated curiosity states, D-type epistemic curiosity appears to be a stronger motive than I-type epistemic curiosity for acquiring knowledge (Litman et al. 2005). However, the underlying reward mechanism for either type of epistemic curiosity remains unknown. Recent research by Kang and colleagues (2009) found evidence of relationships between epistemic curiosity and reward-anticipation-related brain regions, such as the caudate nucleus and lateral prefrontal cortex. While this research is promising, it is still in its infancy, and much more work needs to be done to clarify the underlying mechanisms of reward associated with the satiation of epistemic curiosity (see also Litman (2005) for recent theories on the underlying physiological mechanisms).

Epistemic Curiosity and Learning over the Life Span

When seeking out new information, often individuals may make unexpected discoveries – that is, what they actually learn may differ greatly from what was initially expected to be learned. In past research I-type epistemic curiosity has been found to primarily involve broad exploration of wholly new ideas, whereas D-type curiosity appears to be more concerned with the selection of specific pieces of information that will be incorporated into an existing knowledge-framework. Given these different knowledge-seeking goals, we might also expect that I-type epistemic curiosity would be associated with placing greater value on information that diverges from what one already knows or expects, whereas D-type curiosity would be expected to be associated with placing more value on information that converges with expectations. This is a potentially fruitful area for new research on epistemic curiosity that has not been previously explored.

Cross-References

- ▶ Achievement Motivation and Learning
- ▶ Adaptation and Learning
- ▶ Creativity, Problem Solving and Learning
- ▶ Divergent Thinking and Learning
- ▶ Epistemic Curiosity
- ▶ Interpersonal Curiosity
- ▶ Metacognition and Learning
- ▶ Motivation and Learning
- ▶ Multifaceted Nature of Intrinsic Motivation
- ▶ Self-directed Learning and Learner Autonomy
- ▶ Understanding Intrinsic and Extrinsic Motivation

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Epistemological Beliefs

► Beliefs About Learning

Epistemological Development and Learning

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Synonyms

Beliefs about knowledge

Definition

Epistemology is the study of beliefs about the origin and acquisition of knowledge (Schommer 1994). This entry focuses on personal epistemology. It is important to distinguish between epistemological beliefs and epistemological world views. Epistemological beliefs consist of specific beliefs about a particular dimension of knowledge such as its certainty, simplicity, origin, or justification. In contrast, epistemological world views consist of a set of beliefs that collectively define one's attitudes about the nature and acquisition of knowledge. An epistemological world view includes all of one's explicit and implicit beliefs, attitudes, and assumptions about the acquisition, structure, representation, development, and application of knowledge (Bendixen and Rule 2004; Olafson and Schraw 2006). Recent research has examined teachers' epistemological world views and how these views are related to teaching practice (Maggioni and Parkinson 2008)

Theoretical Background

Types of Epistemological Beliefs

Schommer (1994) described four different and mutually independent epistemological beliefs. The first, *simple knowledge* refers to the belief that knowledge is discrete and unambiguous. Students who score high on this dimension believe that learning is equivalent to accumulating a vast amount of factual knowledge in an encyclopedic fashion. The second dimension, *certain knowledge* pertains to the belief that knowledge is constant: Once something is believed to be true, it remains true forever. The third dimension is *fixed ability*; that is, the belief that one's ability to learn is inborn and cannot be improved through either effort or strategy use. The fourth dimension, *quick learning* refers to the belief that learning occurs quickly or not at all. Students scoring high on this dimension assume (inappropriately) that limited failure is tantamount to permanent failure. If a problem cannot be solved within 10 min, for example, it will never be solved.

In contrast, Hofer (2001) proposed an alternative four-factor framework and developed an instrument called the Epistemological Beliefs Questionnaire (EBQ) to assess these factors. She proposed four factors, which were subsumed under two general dimensions referred to as the nature of knowing and the process of knowing. The former refers to what knowledge is presumed to be, while the latter refers to how one comes to know and understand knowledge. The nature dimension included two factors called certainty of knowledge (i.e., the degree to which one sees knowledge as fixed versus fluid and changeable) and simplicity of knowledge (i.e., the degree to which knowledge is viewed as individual facts versus complex, interrelated concepts). The process dimension included two factors called source of knowledge (i.e., the extent to which credible knowledge is self- or other generated) and