PSYCHOLOGY

Motives underlying human curiosity

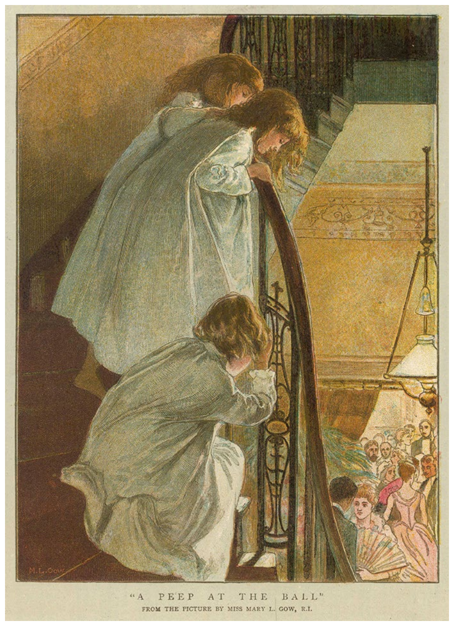
We know that curiosity is a strong driver of behaviour, but we know relatively little about its underlying motives. A new study shows that human curiosity may be driven by diverse motives. While some individuals are primarily motivated to form accurate beliefs, others rather seek information that makes them feel good.

Lieke L. F. van Lieshout, Floris P. de Lange and Roshan Cools

In our everyday lives we are surrounded by an enormous amount of information. We can watch the news to see what is going on in the world around us, or we can check any social media app on our smartphones to know what our friends are doing. But how do we decide what information to look for and what information to ignore? Sometimes, humans seek noninstrumental information: information that is attractive in and of itself, but cannot be used to maximize rewards or to improve performance within the context of a certain task. Little is known about what underlies this curiosity for noninstrumental information.

In a new study, Kobayashi and colleagues show in a large sample of human volunteers that people's curiosity can be driven by heterogeneous motives[1]. This was tested by means of a task in which individuals were presented with two lotteries that were equally relevant to their payoffs. The lotteries differed in terms of both the average amount that would be paid (the reward) and the uncertainty around that amount. The participants were told that one value would be drawn from each lottery and that the sum of both values would be paid out. While participants could not influence their actual payoffs, they could choose which of the lotteries they could see the outcome of, whilst remaining ignorant of the outcome of the other lottery. The aim of this study was to elucidate whether humans want to form accurate beliefs about their total outcome, by choosing to see the outcome of the high-uncertainty lottery, or whether they are driven by what is known as 'anticipatory utility', i.e., the desire to anticipate positive outcomes while avoiding anticipation of negative outcomes. If the latter were true, participants would show a preference for the high-reward outcomes, irrespective of whether this reduces their uncertainty. The novel framework used in this study provided a unique opportunity to tease apart these different motives that might be related to curiosity.

The authors showed that participants' behaviour could be described as a mixture of



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motives related to uncertainty reduction and anticipatory utility. Moreover, the strength of these two motives differed between individuals, and many participants showed a combination of both drives. However, some individuals were driven to reduce their uncertainty and to form accurate beliefs about the total income. Those participants showed a strong preference for the lotteries with highest uncertainty about the payoff, independent of expected rewards. This resonates with previous studies showing that noninstrumental curiosity is driven primarily by uncertainty reduction and that this drive can sometimes supersede the drive for reward[2,3]. Other individuals were driven by the height of the expected rewards, sometimes even regardless of uncertainty. Indeed, evidence from work on observing behaviour in experimental animals shows that targets associated with less uncertainty (Shannon information) can be more attractive[4], suggesting that some individuals are mainly driven by information that makes them feel good, regardless of whether this allows them to better predict their total income. This corroborates recent work showing that participants have a tendency to be curious about future desirable outcomes (gains) and more often choose to be ignorant about future undesirable outcomes (losses)[5]. In that study, participants were willing to pay for knowledge when they were anticipating gains and even willing to pay for ignorance when they were anticipating losses. A related proposal states that a preference for advance information arises because reward prediction errors carried by such advance information boost the level of anticipation (i.e., savouring versus dread). This is supported by findings that subjects prefer advance reward information more strongly when they have to wait longer for rewards[6]. The observation in the current study that a significant proportion of subjects showed a preference for the most uncertain lottery in both gain and loss domains, however, is not easily accounted for by this model and might suggest that participants have an intrinsic drive to reduce uncertainty that is not a simple by-product of reward anticipation.

More generally, one may ask what the psychological and neurobiological mechanisms are that underlie the large individual variability in the degree to which people exhibit specific information seeking drives. For example, one open question is whether the potentiating effect of uncertainty on curiosity reflects an active motivation to resolve the aversive state of not knowing. If so, then our drive to reduce uncertainty might be a function of (beliefs about) the likelihood that uncertainty will be resolved (and thus, curiosity relieved). It may also be related to the degree to which the likelihood of uncertainty resolution can be estimated (as in the case of known risk) or not (as in the case of unknown ambiguity). Furthermore, studies using psychopharmacological manipulations or neurochemical imaging can address questions about the degree to which the effects of uncertainty and anticipatory utility on curiosity reflect variation in levels of distinct neuromodulators, like noradrenaline and dopamine. Such hypotheses would generally concur with extant evidence for noradrenaline and dopamine's respective roles in uncertainty-based exploration[7,8] and reward prediction error coding[9]. However, by addressing the neuromodulation of noninstrumental curiosity, such hypotheses go beyond most existing models of neuromodulator function, which are commonly grounded in a primary drive to maximize reward rather than information (but see, for example, refs. [5,10] for studies that raise hypotheses about a role for neuromodulators in noninstrumental frameworks). Such progress will open avenues for advancing our understanding of the psychological and neurobiological mechanisms of curiosity and, perhaps, ultimately also our ability to enhance it. The present study provides a rich and well controlled framework for pursuing a mechanistic understanding of curiosity, because it allows a quantitative characterization of the degree to which individuals exhibit one or more of multiple curiosity motives. ❐

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Competing interests

The authors declare no competing interests.