Reward is enough for social learning

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Forum

Reward is enough for social learning

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Adaptive behaviour relies on selective social learning, yet the mechanisms underlying this capacity remain debated. A new account demonstrates that key strategies can emerge through reward-based learning of social features, explaining the widely observed flexibility of social learning and illuminating the cognitive basis of cultural evolution.

Why do some people follow the mainstream, whereas others go against the grain? How individuals engage in social learning – learning from others – has long been a central question across the biological and social sciences. There is widespread agreement that adaptive behaviour requires individuals to selectively and strategically use the abundant social information they encounter, including others' actions, emotions, payoffs, and social status. Over the past decades, research has identified at least 26 social learning strategies, such as 'copy the successful' or 'follow the majority' [1]. These strategies are foundational to the field of cultural evolution, which has provided new perspectives on technological progress and cultural change based on rigorous formal models. However, these strategies form a disconnected mosaic, and only recently has attention turned to the logical and mechanistic connections between them [2].

Traditional cultural evolution theory has largely abstracted away from mechanistic detail, treating social learning strategies as genetically encoded, domain-specific heuristics that bias individuals toward particular social cues (e.g., the majority, the successful, or the prestigious). This 'fixed heuristics' view has played a defining role in models of social learning and cultural evolution, but fails to account for the widely observed flexibility [1] and inter-individual variation [3] in social learning. It also cannot explain how different simultaneously deployed strategies are balanced, especially when they conflict, such as when following the majority contradicts copying the successful. This raises two questions: first, what mechanisms can account for these phenomena? Second, can a parsimonious model explain the diversity of social learning strategies?

A reward learning account of social learning

Emerging research is beginning to unify a range of fundamental social learning strategies through models based on reward learning mechanisms. These ideas were originally presented as verbal models, arguing that adaptive social learning is driven by associating social features – like the majority choice or others' payoffs – with personal rewards [2] (see Figure 1 for an illustration). Evidence from animals and humans corroborates the view that reward learning shapes social learning. For example, some social insects use associative learning in copying foraging preferences [4]. In humans, reliance on social learning varies with its adaptive value in everyday subsistence activities [5], and the willingness to take advice is adjusted based on its past usefulness [6]. This experience-based view of social learning has recently been formalised in the Social Feature Learning (SFL) model [7], showing how a spectrum of pivotal social learning strategies can emerge from a single reward learning mechanism (Box 1).

Time scales of flexible social learning

Grounding social learning in reward learning implies that it can be flexibly adapted within an individual's lifetime, suggesting that between-individual and between-group variation may readily emerge from varying local environments [7,8]. Evolutionary models show that the developmental costs of such plasticity can be offset by the benefits of adaptation to dynamic and uncertain environmental and social conditions [8]. Adaptivity in social learning may be further increased if social learning strategies can be communicated (e.g., when reward-predictiveness of social features is verbalised: 'I choose restaurants based on how busy they are rather than looking at online ratings'), enabling the 'social learning of social learning' [3]. This enhanced flexibility might help individuals adapt to modern environments changing at an accelerating pace, fuelled by technological development and social media, but may also promote new and potentially destabilising social learning strategies associated with online rewards, like 'copy the extreme'.

Feature representation and selection

The current implementation of the SFL model [7] considers simple features, but the model can be naturally extended to accommodate more complex social categories. Human feature representation is surprisingly versatile and allows for handling the multidimensional and abstract nature of real-world social cues. Beyond stimulus–reward associations, people can learn to associate abstract categories such as social roles ('teachers' or 'helpers') with reward [9]. Experience may also shape how finely or coarsely features are represented [10], allowing the granularity of social perception to be flexibly modulated. Although the current SFL model uses predefined social features, an extension using deep reinforcement learning could enable individuals to discover relevant features through experience. This attentional selection may, in turn, be influenced by factors such as genetic predispositions, past learning experiences, or teaching. The SFL model provides a formal framework for generating hypotheses about how the

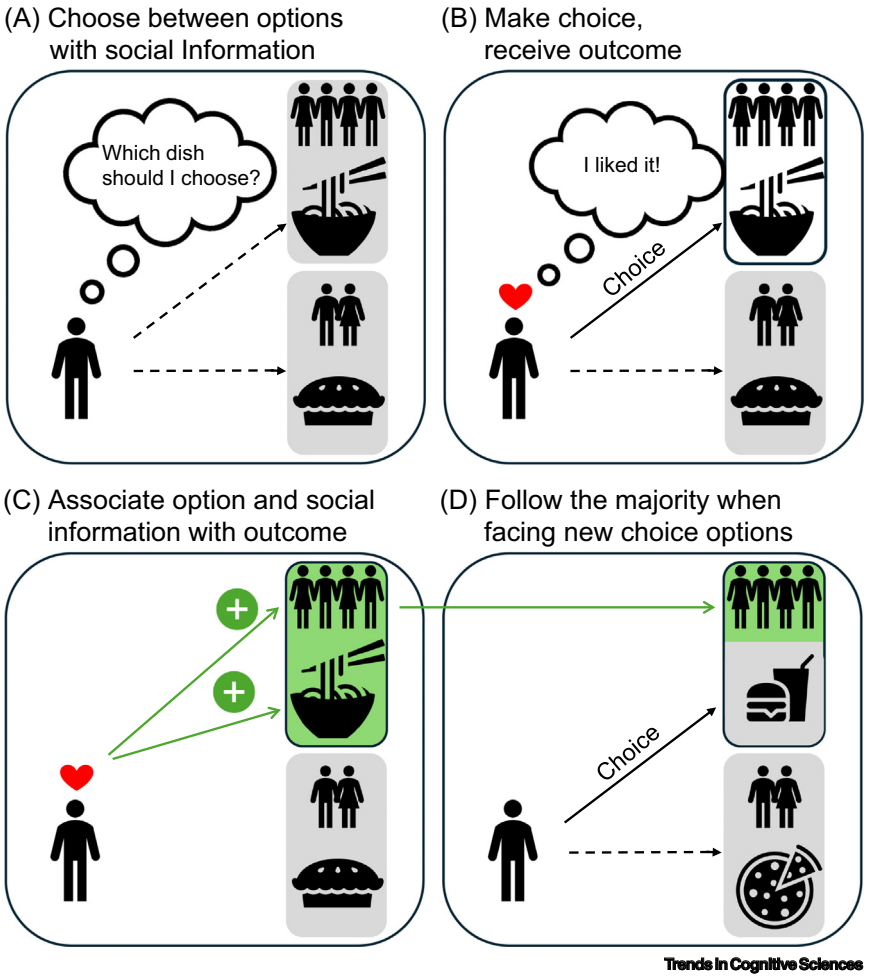

Figure 1. Schematic of how social learning can be learned through reward experience. (A) A learner decides between two different dishes, one of which is chosen by the majority, whereas the other is chosen by the minority. (B) After choosing the majority option, the learner experiences a positive reward. (C) In response, the learner associates both the specific dish and the majority with their positive experience. (D) Having learned that the majority choice is reward-predictive, the learner will be more likely to choose the majority option when faced with novel options.

mechanisms underlying social learning are implemented in the brain, and whether divergent patterns – such as those associated with autism spectrum disorder – can be traced to atypical representations of social features or altered perceptions of social reward.

Model-free and model-based approaches

Social learning involves a range of processes spanning model-free (reinforcement-based learning without internal representations) and model-based (involving internal models of the world and others' minds used for planning). The SFL model focuses on model-free processes, in which social learning strategies emerge from experience. By contrast, model-based perspectives focus on social inference: how people reason about others' mental states and decide how to learn from them [11]. Both model-free and model-based processes can give rise to social learning strategies. Consider age-biased social learning (amplified learning from older compared with younger demonstrators); from a model-free perspective, learners may gradually attend more to older individuals after associating them with better outcomes. From a model-based perspective, learners may infer – without needing prior reward – that older individuals are more knowledgeable. By contrast with model-free learning, model-based learning allows individuals to adjust their behaviour immediately; for instance, upon learning that an older demonstrator is cheating, model-based learners can immediately change their belief that the demonstrator is highly competent and reduce their age-biased learning accordingly [12]. However, model-based processes are computationally demanding and may not always be feasible under attentional or environmental constraints. For example, when faced with abstracted social cues (such as anonymous crowds or aggregated reviews), people may not engage in social inference altogether. Although evidence shows that individuals can switch flexibly between simple and more complex modes of social learning based on their relative usefulness [13], more research is needed to clarify the interplay between model-based and model-free systems in guiding adaptive behaviour.

Cultural dynamics

The SFL model opens new avenues for exploring how flexible social learning shapes cultural dynamics when learning strategies and behaviours continuously reinforce each other. For example, in a hunter–gatherer society, when individuals encounter unfamiliar plants, they may turn to others' choices to avoid potential risks. As more people copy the majority, the local diet becomes increasingly uniform, further reinforcing conformity as it now reliably help to avoid costly mistakes. Moreover, the rewards shaping social learning are not necessarily derived from the nonsocial environment, but may come from the social environment itself, in the form of social approval, acceptance, or recognition. For instance, people may be socially rewarded if they 'listen to their

Box 1. The SFL model

According to the SFL model [7], people perceive the environment as sets of distinct features, which can be nonsocial (such as taste or colour) or social (such as others' choices or payoffs). Instead of learning about objects as a whole, people learn which features predict rewards through a common mechanism rooted in reinforcement learning and generalise this learning to novel situations with similar features. Conflicts between strategies are resolved by comparing the strength of reward associations between different features.

Experiments confirm that people learn which features of their social environment predict rewards and adapt their social learning accordingly [7]. Participants learned to copy behaviours associated with majorities, minorities, and high or low payoffs for others, if these features predicted high payoffs to themselves. Moreover, learned feature–reward associations generalised across contexts, spilling over into dissimilar situations.

Simulations based on the SFL model show that various social learning strategies can emerge as behavioural expressions of learned feature–reward associations. Furthermore, they demonstrate that both within- and between-individual differences in social learning can emerge directly from the stochastic nature of learning experiences across environments [8], suggesting that reward is enough for explaining social learning strategies.

elders', causing age-biased social learning strategies to be favoured even if they do not contain the best guidance for solving problems: a dynamic that may be central to learning cultural norms. We encourage future modelling work to investigate such second-order cultural dynamics emerging from learning of social learning.

Concluding remarks

In this forum article we have reviewed emerging theoretical and empirical insights into a reward learning account of social learning. By casting diverse social learning strategies as manifestations of a common reward-based mechanism, this account offers a mechanistic perspective of human social learning. This framework has the potential to inspire novel theoretical approaches to cultural evolution, with broad implications across fields ranging from social, developmental, and cognitive psychology to anthropology and evolutionary ecology.

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Declaration of interests

No conflicts of interest are declared.

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