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Adaptive cultural transmission biases in children and nonhuman primates

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ABSTRACT

Comparative and evolutionary developmental analyses seek to discover the similarities and differences between humans and non-human species that might illuminate both the evolutionary foundations of our nature that we share with other animals, and the distinctive characteristics that make human development unique. As our closest animal relatives, with whom we last shared common ancestry, non-human primates have been particularly important in this endeavour. Such studies have focused on social learning, traditions, and culture, and have discovered much about the ‘how’ of social learning, concerned with key underlying processes such as imitation and emulation. One of the core discoveries is that the adaptive adjustment of social learning options to different contexts is not unique to human, therefore multiple new strands of research have begun to focus on more subtle questions about when, from whom, and why such learning occurs. Here we review illustrative studies on both human infants and young children and on non-human primates to identify the similarities shared more broadly across the primate order, and the apparent specialisms that distinguish human development. Adaptive biases in social learning discussed include those modulated by task comprehension, experience, conformity to majorities, and the age, skill, proficiency and familiarity of potential alternative cultural models.

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1. Introduction

The adaptive benefits of social learning are well-established and the ability is widespread among a diverse range of vertebrate and invertebrate species. Social learning is fundamental to the maintenance and spread of animal ‘cultures’ or behavioural traditions, and we have extensive observational and experimental evidence for these in animals (Price, Caldwell, & Whiten, 2010). However, to date there exists no strong evidence of significant cumulative culture – cultures that become increasingly complex over time as they do in humans – in other species (Dean, Vale, Laland, Flynn, & Kendal, 2014).

Comparative cultural cognition research typically focuses on differences in the social learning mechanisms underlying culture in human and nonhuman animals. One prominent theory suggests that differences in the specific means by which information is spread between individuals might help explain the lack of cumulative culture in species other than our own (Tennie, Call, & Tomasello, 2009; Tomasello, 1996). The suggestion is that humans tend to copy or imitate with higher fidelity than other species, copying actions, end results, and goals. In contrast, other animals are limited by a tendency to copy only

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some aspects of a behaviour, or only the results of actions (emulation), and precise information regarding actions is not so readily transmitted, leading to cultural “slippage” effects (i.e. the loss of cultural information over time).

Whilst there is certainly evidence to support higher fidelity copying in human children compared to other apes (most typically chimpanzees, e.g. Call, Carpenter, & Tomasello, 2005; Nagell, Olguin, & Tomasello, 1993), both children and chimpanzees have been shown to employ a suite of social learning mechanisms (Whiten, McGuigan, Marshall-Pescini, & Hopper, 2009). Other animals sometimes exhibit imitation (e.g. Voelkl & Huber, 2000; Zentall, Sutton, & Sherburne, 1996), and children can be seen both to selectively imitate in some contexts (e.g. Gergely, Bekkering, & Kiraly, 2002), and ‘overimitate’, copying even causally irrelevant actions, in others (e.g. Lyons, Young, & Keil, 2007; McGuigan, Whiten, Flynn, & Horner, 2007).

Thus, a given individual (or species) does not always apply a single social learning mechanism; rather, they may apply different psychological rules that govern when and from whom to acquire information, and how much of the available information to copy. Such processes have been labeled social learning strategies (Laland, 2004) or cultural transmission biases (Boyd & Richerson, 1985), and may allow an individual to counteract the risk of potentially outdated or maladaptive information (Kendal, Coolen, van Bergen, & Laland, 2005). These biases also likely play a crucial role in determining how behavioural variants are spread and maintained at population levels (Haun, van Leeuwen, & Edelson, 2013).

Comparative research seeking to pinpoint differences underlying cultural transmission biases in humans and other animals has thus risen in prominence. But while transmission biases have been explored separately in both animals (Laland, 2004) and children (Wood, Kendal, & Flynn, 2013a), the comparative exploration of these factors, employing similar procedures in humans and nonhumans, is lacking. Given the rapidly growing scale of recent research, we cannot here provide a comprehensive review of cultural transmission biases; rather, we highlight those that we believe to be particularly good candidates for the exploration of similarities and differences between humans and other primates. Although we note that comparisons between diverse species are essential for a full understanding of how cognition evolves, here we focus on human infants and nonhuman primates (hereafter primates) specifically, because of their central relevance in illuminating the most recent phases of hominin cognitive and cultural evolution. We examine how the context of the learning environment, coupled with the psychological rules the observer is following, helps us better understand the different types of cultural transmission processes observed in human children and primates. Now that we have a substantial corpus of comparative studies focusing on the “how” of social learning with regard to mechanisms, it is important to consider the social and psychological contexts under which different mechanisms are employed, or the “when”, “who”, and “why” of social learning.

2. When to copy

In some cases, it might not be the most adaptive option to learn from watching others, particularly when information gained asocially by one’s own efforts may be more relevant or accurate. Information gleaned from others may be out of date or misleading for a variety of reasons. Choosing between social and asocial learning in any one context can be modulated by the observer’s understanding of the problem, experience, or proficiency. Alternatively, the perceived skill of the model or the number of models displaying a particular behaviour may influence when an individual chooses to copy, as outlined below.

2.1. Task comprehension and experience

A given task may be opaque with respect to the actions needed to complete it, for example because the internal mechanisms are occluded. In such cases, it may be beneficial to apply a “copy-everything” bias to reach a solution. Both preschool-aged children and young chimpanzees have been found to copy all actions, including irrelevant actions, from adult humans when the processes involved in task completion are opaque (Horner & Whiten, 2005).

Children also seem to evaluate a task in relation to a model’s particular actions and efficacy with the task. When faced with a model who performs an action with an unexpected body part without a plausible reason (e.g. turns a light switch on with her head, rather than hand), both 14-month-old infants (Gergely, Bekkering, & Kiraly, 2002) and enculturated chimpanzees (Buttelmann, Carpenter, Call, & Tomasello, 2007) copy the specific method used. When there is an evident reason for the seemingly odd action (e.g. arms are wrapped up or hands occupied), both species copy ‘rationally’, achieving the goal through the more regular means (i.e. manually, in this example). Similarly, children are more likely to seek innovative solutions to a task as the efficacy of a demonstration decreases (Carr et al., 2015) and older children are more likely to reject a model’s demonstration with a non-appropriate tool in favour of a functional tool (DiYanni & Kelemen, 2008). DiYanni and Kelemen (2008) suggest that this was because of older children’s increased knowledge of artefact design.

The difficulty of the task and the cognitive savvy or experience of the observer can both influence the type of social learning mechanism employed. For example, in simpler tasks (e.g. breaking open a tube, or raking in a reward), chimpanzees tend to perform equally well on witnessing information about actions or about end-results only, whereas children require information about actions to perform best (Call et al., 2005; Nagell et al., 1993). In more difficult tasks (e.g. tool construction), chimpanzees may require action information to perform better than controls deprived of information (Price, Lambeth, Schapiro, & Whiten, 2009).

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