

Culture-gene coevolutionary theory and children's selective social learning

Maciej Chudek, Patricia Brosseau-Liard, Susan Birch, & Joseph Henrich

Abstract

Human cognition is unique in the degree to which it is shaped by social learning and cumulative cultural evolution. Importantly, efficient learning does not involve passively absorbing all information that others provide; it is advantageous for a learner to be sensitive to when, if, and for what types of information, others are valuable sources. Several lines of research have begun to elucidate the cognitive mechanisms underlying humans' flair for cultural learning. Among these, Culture-Gene Coevolutionary (CGC) theory focuses on the evolutionary dynamics that faced our emerging cultural species and the learning biases that likely resulted from these selection pressures. CGC theory specifies a suite of hypotheses about which learning biases most effectively extract adaptive information. Here we focus on two types of biases: 'Relative model biases' which help learners identify which models are likely to possess information that is applicable for them given the particular social groups to which they belong; and 'Absolute model biases' which help learners select models who are most likely to possess better information in an absolute sense. We discuss these biases in light of recent developmental findings and advocate for CGC theory as a useful framework for organizing, understanding, and generating research on children's selective social learning.

Introduction

Why does our social cognition develop as it does? Why do young minds possess the specific cognitive mechanisms that they do, not some other set? What's hard about answering these questions is that it's so easy. For any aspect of social cognition, you can easily generate tens of plausible evolutionary stories about how it helped our ancestors survive (really, try it

with a friend). Unfortunately the meagre traces left by the past make most evolutionary stories impossible to either verify or refute.

Verifiable ultimate explanations pose the much harder challenge of deducing the past without reference to modern social cognition. By starting from physical evidence of our species' history, we can reason forward by way of explicit, typically mathematical, arguments grounded strictly in evolutionary theory. The resulting ultimate theories can generate falsifiable a priori predictions about modern cognition. Though they remain hard to definitively verify as explanations for any single social-cognitive-developmental effect, they can be tested by their ability to integrate a broad spectrum of evidence under the umbrella of very few assumptions about the ancient past.

Here we review Culture-Gene Coevolutionary (CGC) theory (e.g., Boyd & Richerson, 1985; Mesoudi, 2009; Richerson & Boyd, 2005) which, taking just this tack, predicted in advance several recent findings on the development of social cognition. First we briefly describe the evolutionary dynamics that ground CGC. We then review the predictions that these dynamics entail for the development of social cognition and their fit to recent findings.

Evolved Cumulative Cultural Learning and the Development of Social Cognition

Though some cultural learning – that is, the transmission of behaviours from one individual to another by observation – is present in other species, only humans learn faithfully enough that culture accumulates and gradually generates complex behaviours, such as baking and origami. This, along with other evidence (e.g., see Richerson & Boyd, 2005), suggests that the sophisticated, metabolically expensive brains required for cumulative cultural learning are selected against until a species' cultural repertoire can provide a substantial fitness improvement. Once this threshold is passed, culture accumulates and its fitness consequences grow exponentially; a positive feedback that generates strong genetic selection for brains better at cultural learning.

Since culture changes much faster than genes, direct genetic adaptations for better cultural learning can only exploit features common across social groups and generations. Fortunately, there are a number of cues that can reliably distinguish better from worse models or informants across time and groups. CGC theorists have outlined several ecological cues that any highly cultural species should exploit. In particular, ‘model biases’ – features of cultural models (i.e. other individuals) that reliably indicate bearers of better (i.e. more fitness enhancing) cultural knowledge – imply phenotypic predictions about the development of social cognition. These predictions can be divided into two classes: ‘relative model biases’ help learners identify models possessing knowledge relevant to them (i.e., it applies to their age, sex, social or cultural group), and ‘absolute model biases’ help identify models whose cultural knowledge is just better (e.g., more accurate or useful).

Next, we’ll briefly explain the logic of each prediction and its fit to recent evidence. Some predictions will seem quite obvious to readers fortunate enough to have already studied modern human children, but remember: the test of ultimate theories isn’t how well they explain any one effect (that’s easy), it’s how easily they account for a vast range of modern phenomena, even retrospectively obvious ones, by reasoning forward from when they didn’t exist, invoking as few assumptions as possible.

Relative Model Bias: Age

During humans’ juvenile period different behaviours enhance fitness than during adulthood. Consequently, selection will consistently favour cultural learners who discriminate potential models by age over less discriminate learners; particularly favouring a disposition to learn from ‘slightly older’ models (Henrich & Gil-White, 2001). Consistent with this simple prediction, young children do seem to assess the age of cultural models: they prefer older models unless they have proven unreliable (Jaswal & Neely, 2006), but younger models in domains relevant to young people (e.g., toys: VanderBorghet & Jaswal, 2009); and

are more likely to learn preferences (Shutts, Banaji, & Spelke, 2010), and a variety of other behaviours (see Hilmert, Kulik, & Christenfeld, 2006) from similarly aged models.

Relative Model Bias: Self-similarity (including sex)

Sexual and social divisions of labour are common in contemporary foraging societies. Such divisions that were present in ancestral societies would have favoured learners who prefer learning from models who are most 'like them' (e.g. same sex, same social group, etc) (Henrich & Gil-White, 2001; Henrich & McElreath, 2003). Evidence that children preferentially learn from self-similar, particularly same sex models, is decades old (e.g., Rosekrans, 1967; Wolf, 1973) and recent work has shown that they preferentially acquire same-sex models' preferences (Shutts, et al., 2010). Moreover, children (Gottfried & Katz, 1977) and adults (e.g., Hilmert, et al., 2006) seem particularly disposed to learn from those who share their existing beliefs.

Relative Model Bias: Ethnicity (including language and accent)

The use of fitness-neutral cues to distinguish cultural groups, or ethnicity (e.g., body markings, accent) is a natural consequence of cultural learning (McElreath, Boyd, & Richerson, 2003). Another consequence is plentiful 'coordination dilemmas' – situations where it pays to behave like your group-members (e.g. norms, etiquette, morals). Together these lend selective advantage to young learners who prefer learning from their co-ethnics.

Five- to 6-month-olds prefer looking at individuals with familiar accents, 10-month-olds prefer accepting toys from and eating food associated with linguistic co-ethnics, while 5-year-olds prefer them as playmates (Kinzler, Dupoux, & Spelke, 2007; Kinzler, Shutts, DeJesus, & Spelke, 2009; Shutts, Kinzler, McKee, & Spelke, 2009). Four- to 5-year olds preferentially trust novel object functions demonstrated by a native-sounding speaker who speaks only nonsense syllables (Kinzler, Corriveau, & Harris, 2010). Five-year-olds also make potent social inductions on the basis of ethnic labels (Diesendruck & HaLevi, 2006).

Absolute Model Bias: Skill

A young mind that can perceive skill¹ differences between potential models can make wiser learning decisions. For instance, young learners might infer the better hunter by who throws further. Termed ‘skill-bias’, CGC theorists predicted that cultural learners will exploit perceptible skill differences (Henrich & Gil-White, 2001; Henrich & McElreath, 2003).

Recent investigations have repeatedly demonstrated that children who witness obvious skill differences prefer learning novel object labels (e.g., Koenig & Harris, 2005; Scofield & Behrend, 2008) and functions (e.g., Birch, Vauthier, & Bloom, 2008) from more accurate models, even after a one week delay (Corriveau & Harris, 2009b), even when only the more skilled model is a stranger (Corriveau & Harris, 2009a); for a review see Gelman (2009). Besides their names and functions, children also seem sensitive to models’ skill at predicting objects’ non-obvious causal properties (Sobel & Corriveau, 2010). Young children also prefer learning from more confident cultural models (Birch, Akmal, & Frampton, 2010; Jaswal & Malone, 2007; Sabbagh & Baldwin, 2001), potentially exploiting the model’s own assessment of his or her skill.

Absolute Model Bias: Success

Skill differences are often opaque, especially in the limited time learners have to make a decision. For instance, though the relative quality of two adults’ diets may be apparent after several years, young learners must choose what to eat for dinner tonight. The cumulative consequences of skill, termed ‘success’ (e.g. a fat belly, fine ornamentation, good outcomes in life) are often rapidly apparent, even when the mechanisms that generated them are not (Boyd & Richerson, 1985; Henrich & Gil-White, 2001; Henrich & McElreath, 2003). Interestingly, a sensitivity to cues to success may even explain why both North American (Olson, Banaji, Dweck, & Spelke, 2006) and Japanese (Olson, Dunham, Dweck, Spelke, &

¹ By ‘skill’ we just mean ‘whatever behaviour produces higher fitness on average’.

Banaji, 2008) 5- to 7-year-olds report liking and judging as nicer individuals who've experienced seemingly random, or at least unexplained, positive outcomes as well as members of groups that experience more positive outcomes.

Absolute Model Bias: Prestige

The trappings of success vary across time and societies: e.g., a fat belly carries different implications now than it did once. However, one feature is reliably shared by skilled cultural models across generations and societies: other learners also prefer to learn from them.

Henrich and Gil-White (2001) predicted a cultural species would possess a disposition to prefer learning from whomever others are learning from, termed 'prestige-bias'.

Young children prefer learning from models who bystanders have previously watched, smiled at and agreed with (Fusaro & Harris, 2008); however such explicit agreement could also cue the models' ethnicity, her prior accuracy, or how common (rather than accurate) her opinions are. Our own recent work (Chudek, Heller, Birch, & Henrich, in prep) specifically tested the unique effects of prestige by demonstrating that children prefer learning from adult models who bystanders have merely preferentially attended to (i.e. no endorsement or positive affect). Moreover, this effect seems domain sensitive – adults watched by bystanders while using tools are preferentially trusted for tool-use techniques but not food preferences. Our work with adults suggests that similar cues produce enhanced recall for whatever a 'looked at' model said (Chudek, Mushinski, & Henrich, in prep).

Overview

Humans are undeniably a highly cultural species. For instance, children trust the testimony of adults over their own perception (Jaswal & Markman, 2007; Topál, Gergely, Miklosi, Erdohegyi, & Csibra, 2008) and imitate adults' obviously redundant actions (Lyons, Young, & Keil, 2007), even when accuracy is incentivised (Jaswal, 2010). CGC predicts which phenotypes – that is, individuals' actual judgements and behaviours – are robustly

selected for in a species dependent on cultural learning. These predictions apply equally to the social cognition of any sufficiently cultural species.

CGC reasoning, which unfolded in isolation from developmental research but fits well with recent findings, implies selection for whatever genetic adaptations produce these adaptive phenotypes. So, far from competing with or contradicting proximate explanations, *a priori* ultimate theories like CGC are consistent with most cognitive mechanisms proposed by developmental psychologists and can compliment and help conceptually organise the diverse findings emerging from developmental investigations of social cognition. They answer questions on a different level: rather than explaining what cognitive mechanisms make children behave as they do, they help us understand why these mechanisms in particular should exist. They are also an excellent source of generativity, suggesting previously unconsidered phenomena – such as prestige bias – worthy of empirical study and proximate explanation. Therefore we propose CGC theory as a useful framework for organizing, understanding, and generating a plethora of findings on children’s selective social learning.

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