Cultural evolution of categorization

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Abstract

Categorization is a fundamental function of minds, with wide ranging implications for the rest of the cognitive system. In humans, categories are shared and communicated *between* minds, thus requiring explanations at the population level. In this paper, we discuss the current state of research on the cultural evolution of categorization. We begin by delineating key properties of categories in need of evolutionary explanation. We then review computational modeling and laboratory studies of category evolution, including their major insights and limitations. Finally, we discuss remaining challenges for understanding the cultural evolution of categorization.
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1. Introduction

Categorization is a core cognitive skill, with wide-ranging implications for the rest of the cognitive system. Categories allow us to parse our interactions with the world, and divide complex and otherwise chaotic stimuli into discrete kinds. Thus, an individual furry moving thing becomes an instance of the category *cat*, which in turn allows us to reason that it would be a bad idea to tug on its tail. In such instances of categorization, perceptual information is compressed and classified on the basis of its relationship to some other previously perceived or conceived category, contextualizing the new stimulus by virtue of similarity or analogy to contexts stored in memory (French, 1995; Hofstadter & Sander, 2013). Novel properties of the present stimuli can be used to adjust or expand existing categories as well as to create new categories.

Although categorization is widely studied in humans, it is a cognitive ability that is necessarily widespread across the animal kingdom, since adaptive decision making is enhanced for those individuals who can best make sense of the world around them. A fascinating example comes from the California ground squirrel, who in the presence of predatory snakes often exhibit "tail flagging," in which the squirrel rears up and waves its tail vigorously (Rundus, Owings, Joshi, Chinn, & Giannini, 2007). This prompts the snake to shift its own behavior from predatory to defensive. Ground squirrels not only distinguish snakes from other stimuli, but also notice the difference between rattlesnakes, which are sensitive to infrared signals, and gopher snakes, which are not. In the presence of the former but not the latter predator, ground squirrels will pump blood into their tails while flagging, a costly behavior that is detectable by rattlesnakes but not gopher snakes.

However, a major consideration for the study of categorization in *humans* is that humans are profoundly cultural creatures. We show unusually high levels of cooperation

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and communication, at a degree of complexity that is not seen in other species. Some non-human species are social, and are able to communicate information in ways that reflect the use of elementary "cultural categories." The alarm call system used by vervet monkeys (Seyfarth, Cheney, & Marler, 1980) is a well-known example. Nevertheless, few if any non-human species have *cumulative* culture, in which technological and institutional forms can build on innovations from prior or concurrent generations (Boyd & Richerson, 1996; Legare, 2017; Tennie, Call, & Tomasello, 2009). For we humans, culture pervades cognitive and social experience, and thus the cultural nature of our categories is more entrenched. We use categories for talking amongst ourselves about the world, and also for talking about ourselves and others. Communication and coordination in humans require convergence on shared concepts that facilitate common goals, joint attention, and consistent norms and institutions (Chwe et al., 2001; Clark, 1996; Skyrms, 2004; Smaldino, 2014; Tomasello, 2009). Our categories must therefore not only be internally consistent; they must be culturally consistent.

Language is often seen as a vehicle for this kind of parcellation of a complex and variegated world. Categorical terms like "cat" are a big part of the lexicon of each individual language. Different languages carve up the world in different manners, with some stunning differences in domains such as spatial categories (Levinson & Brown, 1994; Majid, Bowerman, Kita, Haun, & Levinson, 2004), color (Kay, Berlin, Maffi, Merrifield, & Cook, 2009), and kinship (Kemp & Regier, 2012). For this reason, language is a critical human skill, subject to functional considerations–such as how a set of semantic categories can help a linguistic community navigate and survive in its environment. Indeed, language is widely discussed in the realms of biological and cultural evolution (Christiansen & Kirby, 2003; Fitch, 2010; Hurford, 2012). Categorization, surprisingly, is less often integrated in evolutionary questions, despite its core cognitive significance.

Although the cultural features of categories may ultimately manifest in language, there are many important social domains for which the cultural aspects of categorization are paramount. Some examples include:

- *Social identity.* Humans readily classify people into groups and roles that facilitate decision making related to interaction. Such categories are imperative for coordination and assortment in cooperative and competitive tasks (Smaldino, 2018), including evaluating potential mates (Miller & Todd, 1998).
- *Morality.* Categorizing behaviors as moral, ethical, or legal facilitates a convergence on norms that is necessary for cultural cohesion (Curry, 2016).
- *Emotion.* Interpretations of emotional signals are often bound to context and the culturally appropriate expressions for those contexts (Barrett, Lindquist, & Gendron, 2007).

- *Personality.* The way we describe others relies on finding regularities among behaviors and contexts that are useful for prediction, and these regularities are at least partly culturally determined (Gurven, Von Rueden, Massenkoff, Kaplan, & Lero Vie, 2013; Lukaszewski, Gurven, von Rueden, & Schmitt, 2017).

Reliance on the categories in the preceding list did not arise spontaneously with the emergence large brains during the course of our evolution. Nor did they emerge through individual learning processes as a result of a shared environment. Many salient categories in human cultures must necessarily arise through cultural processes. And because cultures last far longer than individual lifespans and change through well studied mechanisms (Boyd & Richerson, 1985; Mesoudi, 2011; Turchin, 2003), many properties of human categories and categorization require explanations in terms of cultural evolution.

In this paper, we discuss the current state of research in understanding the cultural evolution of categorization. We begin by delineating key properties of categories in need of evolutionary explanation. We then review computational modeling and laboratory studies of category evolution, including major insights and limitations. Most of the approaches that we review focus on the cultural evolution of *category terms* and their relationship to the environment. Because of this focus on category terms, prior studies also reflect categorization itself. We will also argue that understanding category systems as the locus of evolutionary dynamics may inform the study of language evolution in interesting ways. More broadly, taking categorization as central may help to integrate various aspects of the debate on cognitive evolution. We will conclude with some remaining challenges for understanding the cultural evolution of categorization.

2. Features of categories and concepts

For the purpose of evaluating the approaches to the evolution of categories, it is useful to review some of the relevant features of categorization, concepts and their relationship to language. Because of how vast the field of research in concepts and categories is, we will focus on features most relevant to our present goal. Reviews on categorization abound (for authoritative reviews see Cohen & Lefebvre, 2005; Murphy, 2004; Pothos & Wills, 2011), but some of its core properties can be summarized succinctly.

Terminologically, we use the term "concept" to refer to the *psychological representation* of a category, which allows for the categorization of stimuli. We use the terms "categories" or "categorical structure" to refer to the partitions of the world that are relatively stable and distributed widely in a population (Ross & Tidwell, 2010). The latter is encoded in the population's categorical language, shared knowledge structure, and institutions. Categories and concepts are not independent—shared cultural categories may