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The Development of Cumulative Cultural Learning

Cristine H. Legare

Department of Psychology, The University of Texas at Austin, Austin, Texas 78712, USA; email: legare@austin.utexas.edu

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Abstract

Human culture is unique among animals in its complexity, variability, and cumulative quality. This article describes the development and diversity of cumulative cultural learning. Children inhabit cultural ecologies that consist of group-specific knowledge, practices, and technologies that are inherited and modified over generations. The learning processes that enable cultural acquisition and transmission are universal but are sufficiently flexible to accommodate the highly diverse cultural repertoires of human populations. Children learn culture in several complementary ways, including through exploration, observation, participation, imitation, and instruction. These methods of learning vary in frequency and kind within and between populations due to variation in socialization values and practices associated with specific educational institutions, skill sets, and knowledge systems. The processes by which children acquire and transmit the cumulative culture of their communities provide unique insight into the evolution and ontogeny of human cognition and culture.

Contents

INTRODUCTION

The primary task of development is to learn the languages, beliefs, skills, and practices associated with the communities children belong to (Cole 1996, Legare & Nielsen 2015). In the span of a few years, children can learn complex knowledge systems that it took millennia for human populations to develop (Henrich 2015). What explains the development of our precocious and sophisticated cultural learning capacities?

Because humans are an altricial species, infants are born dependent on caregivers for survival (Geary & Bjorklund 2000). The unusually long juvenile period in humans is a product of natural selection and supports the development of cognition via prolonged social interaction and learning from others (Bjorklund 2018, Bjorklund & Ellis 2014, Gopnik et al. 2017). Extended adolescence is critical for a species that inhabits highly diverse cultural ecologies and ecosystems and that must acquire complex, diverse, and specialized systems of knowledge to survive and thrive (Lancy 2008).

The cultural, linguistic, and educational technologies, practices, and institutions of particular populations shape cognitive and social development (Cole 1996, Gurven et al. 2017, Heyes 2018, Laland 2017, Pinker 2010, Ritchie & Tucker-Drob 2018). The capacity to acquire highly variable and complex cultural repertoires requires a cognitive system unmatched by other species in flexibility and plasticity (Konner 2010, Pagel & Mace 2004). Sperber (1985, p. 73) aptly described the content of culture as "distributions of representations in a human population, ecological patterns of psychological things." An explanation of cultural phenomena requires describing "either mental representations inside brains, or public representations in the environment of brains" (Sperber 1985, p. 73).

Decades of research in comparative psychology, biological anthropology, and behavioral ecology have demonstrated that humans are not the only animals to create and transmit culture (Herrmann et al. 2007, van Schaik & Burkart 2011, Whiten & van Schaik 2007). If culture is

defined as "group-typical behaviors shared by members of a community that rely on socially learned and transmitted information" (Laland & Hoppitt 2003, p. 151), many species have culture (Aplin et al. 2015, Fragaszy & Visalberghi 2004, Leadbeater 2015, Plotnik et al. 2011, Rendell et al. 2010). Animal species ranging from humpback whales to chimpanzees acquire and transmit group-specific behavior (Cantor et al. 2015, Fragaszy & Perry 2003, Garland et al. 2013, Laland & Galef 2009, van Leeuwen et al. 2014). Culture in humans, however, is unique in its variation, its complexity, and, importantly, its cumulative quality (Dean et al. 2014, Johnson-Pynn et al. 2003). The knowledge, skills, and practices of human culture vary more within and between populations than any other species (Konner 2010).

This article first explains our species-specific propensity for cumulative culture and discusses the cognitive foundations of cumulative cultural learning. Then, it describes the learning processes that enable children to acquire and transmit culture and explains how these processes are shaped by the ecologies, economies, and educational systems of particular populations. Finally, it concludes with a discussion of how these complementary and interactive processes drive the accumulation of cultural insights and innovations within a single generation (horizontal transmission) and between generations (vertical transmission).

CUMULATIVE CULTURE

In the span of a few thousand years, human technology has gone from stone tools to smartphones. The cumulative quality of cultural innovation means that individuals take existing technologies and modify them, often adding design features that improve and enhance their intended functions (Henrich 2015). For example, ancestral humans took crude Oldowan single-face stone tools and modified them to create bifacial Acheulean hand axes by adding improvements such as handles facilitating grip, although it took a million years to do so. The technological repertoire of human populations now includes millions of different kinds of tools and artifacts modified from previous versions (Legare 2017, Legare & Nielsen 2015). No other species on Earth currently possesses this fundamental characteristic of cumulative culture (Laland 2017). Humans live and learn in diverse cultural ecologies that are the product of the cumulative innovations of previous generations (Odling-Smee et al. 2003, Scott-Phillips et al. 2014, Whiten et al. 2011). The processes by which social and technological innovations are incorporated into a cultural repertoire to create more complex bodies of socially heritable knowledge are called cumulative culture (Boyd et al. 2011, Kurzban & Barrett 2012, Pagel 2012, Pradhan et al. 2012, Whiten & Erdal 2012).

Cumulative culture makes individuals more innovative by allowing for the accumulation of solutions to problems that can be modified and combined to create new technologies (Henrich 2015). Technologies and tools are often too complicated for individuals to understand, much less develop from scratch within one lifetime (Muthukrishna & Henrich 2016). Consider brewing a cup of coffee. Could a single individual independently discover how to grow and cultivate the correct kind of beans, harvest them at the correct time, roast them at the correct temperature for the correct length of time, grind them to a powder, brew them, and produce the caffeinated beverage revered the world over (Christakis 2019)? The invention of technology this complex is possible only through cumulative cultural transmission. Cumulative cultural transmission entails retaining some existing practices and techniques, discarding others, and adding innovation incrementally through a process of recombination (Muthukrishna & Henrich 2019). This process can produce occasional qualitative changes due to the incorporation of novel technologies (Kolodny et al. 2015, Stout & Hecht 2017). Both individual- and group-level innovation are made possible by accumulated cultural knowledge (Henrich 2015).

COGNITIVE FOUNDATIONS OF CUMULATIVE CULTURAL LEARNING

What explains the uniquely human capacities to rapidly acquire, accumulate, and build upon the discoveries of previous generations? One hypothesis is that human brains are exceptional in size, processing speed, and computational power. Human brains are substantially larger than chimpanzee brains and have increased dramatically over the course of several million years of hominin evolution (Bailey & Geary 2009). Our sophisticated and powerful brains are insufficient to explain the variation and complexity of human culture, however. For example, the exponential increase in technological and cultural complexity is a relatively recent event in human history (occurring primarily in the last 10,000 years), with no evidence for correspondingly significant changes in neural complexity or brain size during this period (Muthukrishna & Henrich 2016). In fact, demographic changes in population size and density are better explanations for increases in symbolic and technological complexity than changes in cognitive capacity during that time period (Powell et al. 2009). Other hypotheses for cumulative culture in humans include general cognitive mechanisms, language, prosociality, cooperation, morality, imitation, and teaching (Boyer 2018, Claidière & Sperber 2010, Dean et al. 2012, Heyes 2018, Laland 2004, Legare & Nielsen 2015, Marshall-Pescini & Whiten 2008, Muthukrishna et al. 2016, Tennie et al. 2009, Tomasello 2019). Although there are disagreements and debates about the relative influence of this suite of capacities on our species-specific propensity for cumulative culture, there is a consensus that the ability to learn socially is critical to this process. Comparative research with nonhuman primates indicates that in contrast to human children, their capacity for social learning is relatively limited (Tomasello 2019), albeit not absent (Whiten 2017). For example, despite comparably sophisticated physical causal reasoning, preschool children far surpass adult chimpanzees in measures of social learning (Herrmann et al. 2007).

Human minds are complex learning systems. The beliefs and behaviors of populations are transmitted within and between generations through social learning processes (Dean et al. 2012, Hewlett & Roulette 2016, Legare & Nielsen 2015, Mesoudi et al. 2016, van Schaik & Burkart 2011, Whiten & van Schaik 2007). "Learning that is influenced by observation of, or interaction with, another animal (typically a conspecific) or its products" (Heyes 1994, p. 207) is social. Young children are highly skilled at mastering the beliefs and practices of their communities, an achievement made possible by several psychological processes that enable social learning (Legare & Harris 2016). Social learning is supported by early-developing social cognitive capacities, including cognitive flexibility, theory of mind, norm psychology, and prosociality. Next, I review evidence for universality and flexibility in these cognitive capacities and discuss how they facilitate social learning.

Cognitive Flexibility

For learned behavior to be considered cultural, it should be transmitted within a group and maintain stability over time (Claidière & Sperber 2010, Mathew & Perreault 2015). The cognitive processes that allow children to acquire and transmit cultural knowledge and skills are universal but sufficiently flexible to allow them to learn group-specific beliefs and behaviors (Legare & Harris 2016). Cumulative culture requires learning processes that support the acquisition of knowledge, skills, and practices from other group members (Chudek & Henrich 2011, Creanza et al. 2017, Legare & Nielsen 2015). The cultural ratchet effect (Tomasello et al. 1993) is the process by which learners accumulate, modify, and improve upon information from others (Herrmann et al. 2007, Mesoudi 2017, Tennie et al. 2009, Tomasello 2016). Cumulative culture also requires learning processes that support the capacity to innovate in order to respond flexibly to novel challenges

and environments (Arbilly & Laland 2017, Carr et al. 2016, Henrich & McElreath 2007, Legare & Nielsen 2015, Lotem et al. 2017). In order to innovate, a learner must be capable of behavioral flexibility, defined as "the continued interest in and acquisition of new solutions to a task, through either innovation or social learning, after already having mastered a previous solution" (Lehner et al. 2011, p. 447). Behavioral flexibility allows individuals to build upon existing behaviors by discarding previous solutions in favor of more productive or efficient ones (Davis et al. 2016).

The cognitive processes supporting behavioral flexibility develop rapidly in childhood (Zelazo et al. 2008). The development of cognitive flexibility and other executive functions, including inhibition, attentional control, and working memory, underpins the abilities to make plans, solve problems, and learn new information (Blair & Razza 2007, Diamond 2013, Jurado & Rosselli 2007). Like all psychological capacities, cultural experience shapes cognitive flexibility (Chen et al. 1998; Lan et al. 2009, 2011). For example, cross-cultural research with 3–5-year-olds in the United States and South Africa has revealed that whereas the development of word-learning flexibility is similar across populations, the development of abstract rule-switching flexibility is more variable, potentially due to greater dependency on experience with formal education (Legare et al. 2018b). Thus, the development of the psychological processes underlying cognitive flexibility is shaped by culturally specific experiences.

Theory of Mind

The ability to reason about the inner workings of our minds and the minds of others is critical to efficient social learning (Heyman & Legare 2013). Children across highly diverse populations reliably develop theory of mind, the ability to attribute mental states such as desires, beliefs, intentions, knowledge, and emotions to others and to recognize that others' mental states can differ from one's own (Barrett et al. 2013, Premack & Woodruff 1978, Slaughter & Perez-Zapata 2014). The ability to accurately recognize a false belief in others is the most challenging aspect of theory of mind development in early childhood (Tomasello 2018). Yet, children from populations as diverse as Canada, India, Peru, Samoa, and Thailand pass the false-belief task at around the same time, suggesting continuity in theory of mind development around the world (Callaghan et al. 2005). There is some variation, however, in the age at which children acquire particular kinds of knowledge about theory of mind (Callaghan et al. 2005, Liu et al. 2008, Slaughter & Perez-Zapata 2014, Wellman & Liu 2004, Wellman et al. 2006). Australian, US, and European children between the ages of 3 and 5 years learn the following five components of theory of mind sequentially: diverse desires, diverse beliefs, knowledge access, false beliefs, and hidden emotions (Wellman & Liu 2004). Although the timing of initial development is similar in toddlers across all populations studied, the sequence of components of theory of mind reasoning varies to some extent between populations. For example, Chinese and Iranian children understand knowledge access before Western children, but take longer to understand false beliefs. One potential explanation for this difference in the development of theory of mind reasoning is socialization of collectivism, the emphasis on cohesiveness of individuals in groups and prioritizing others over self, in Iran and China and socialization of individualism, the emphasis on independence and prioritizing self over others, in Western populations (Liu et al. 2008, Schwartz 1990, Shahaeian et al. 2011, Wellman & Liu 2004). Greater emphasis on differences between self and others may cause Western children to understand that other people have different beliefs than their own relatively sooner. These studies reveal that group-specific social input and experience in interaction with genetic factors (Kitayama et al. 2014) shape when and how children understand and reason about the mind (Slaughter & Perez-Zapata 2014).

Norm Psychology

Children have early-developing norm psychology (Chudek & Henrich 2011, Diesendruck & Markson 2011) that guides their attention to group expectations for beliefs and behavior (Rakoczy & Schmidt 2013). Several cognitive biases influence the development of norm psychology (Chudek et al. 2012). For example, homophily, a preference for similar others, and consensus, the expectation that group members will behave in similar ways, are detectable in early childhood (Corriveau et al. 2013, Kinzler et al. 2007, Muthukrishna et al. 2016, Schmidt et al. 2016). Young children are attentive to information about social norms or rules (Rakoczy & Schmidt 2013) and actively enforce them (Schmidt & Tomasello 2012, Schmidt et al. 2011). They categorize based on social groups (Killen & Rutland 2011) and view them as stable and unchanging (Gelman et al. 2007, Rhodes 2012). Preferences for in-group members and expectations for reciprocity develop in early childhood (Dunham 2018, Wen et al. 2016). Children across diverse populations also engage in majority-based transmission, although this preference may be more pronounced in early childhood and adolescence than in middle childhood (van Leeuwen et al. 2018).

The proclivity to conform to the behavior of others underpins the development of norm psychology (Legare et al. 2018a). Behavioral conformity is likely universal; however, there is substantial variation between populations in the extent to which conformity is valued and interpreted. For example, in many populations around the world, behaviors consistent with conformity, including helpfulness, obedience, and social responsibility, are associated with competency (Clegg et al. 2017, DeLoache & Gottlieb 2000, Harkness & Super 1992, Hess et al. 1987, Serpell 1993). Other populations associate nonconformity or creativity with intelligence. For example, highly educated adults from the United States are more likely to associate intelligence with creativity than conformity, often citing innovation and independence as justifications for their competency judgments. In contrast to US adults, however, US children and adolescents display a strong conformity bias when evaluating the intelligence of other children. There is also substantial variation within populations in perceived relations between conformity, creativity, and competency. For example, higher socioeconomic status adults from the United States are more likely to endorse low conformity children as intelligent than are lower socioeconomic status adults (Legare et al. 2018a). In sum, children acquire beliefs about the relations between conformity, creativity, and competency in line with social norms (Legare et al. 2018a).

Prosociality

Prosociality and a sense of fairness facilitate successful social interaction and underpin expectations for reciprocity (Claidière et al. 2013, 2015; Dahl & Brownell 2019). These early-developing and universal capacities are shaped by culturally specific norms and expectations of obligations to others (Aknin et al. 2015, Blake et al. 2015, House & Tomasello 2018, House et al. 2013, Messer et al. 2017, Rakoczy et al. 2009). For example, a cross-cultural study of children from seven populations documented that disadvantageous inequity aversion (peer receives more than self) is evident by middle childhood in all populations. In contrast, advantageous inequity aversion (self receives more than peer) emerges later in childhood and is not universal (Blake et al. 2015). A cross-cultural study of resource distribution and turn taking among German and Kenyan children revealed cultural variability in turn taking, suggesting that this is a normative practice that varies by context (Zeidler et al. 2016). The values and norms of particular cultural contexts shape group-specific expectations for social obligation, interaction, and equitable division of resources.

In sum, the ability to learn from others is made possible by a suite of early-developing cognitive capacities, including cognitive flexibility, theory of mind, norm psychology, and prosociality. Taken together, developmental research across diverse populations demonstrates that although

cognitive proclivities to learn social information are universal, there is substantial variation within and between populations in their development.

CUMULATIVE CULTURAL LEARNING PROCESSES

Children use a suite of cultural learning capacities, all of which support the acquisition and transmission of the diverse knowledge systems and technologies associated with human culture (Boyd & Richerson 1985, Tomasello et al. 1993). These cultural learning processes include exploration, observation, participation, imitation, and instruction.

Learning Through Exploration

Children are actively engaged in learning about the world around them (Alvarez & Booth 2013, Gopnik & Sobel 2000, Schulz 2012). They explore in collaboration with caregivers, educators, siblings, and peers (Callanan et al. in press, Gweon & Schulz 2019, Legare et al. 2017). Children readily seek to understand outcomes and events in their environment (Gopnik 2000). They elicit and produce verbal information about causal mechanisms and relations that allows them to construct, constrain, and evaluate their beliefs about how things work (Legare & Lombrozo 2014, Walker et al. 2014). Children also explore in ways that generate relevant information from others or the environment (Legare et al. 2017). Exploration provides a mechanism for testing hypotheses about causal mechanisms and for discovering that there is more to understand (Sobel & Sommerville 2010). These processes work in tandem to allow children to build more accurate and complex understandings of their environments (Callanan et al. in press, Legare 2014, Legare et al. 2017).

Children construct new knowledge by updating and revising previous beliefs (Busch & Legare 2019). They are characteristically curious (Jirout & Klahr 2012, Legare 2014) but are not interested in understanding everything. They are particularly interested in learning about surprising, unexpected, and informative (e.g., potentially dangerous) events and outcomes (Barrett et al. 2016). Infants (Stahl & Feigenson 2015) and young children explore unexpected, ambiguous, and inconsistent outcomes and events (Bonawitz et al. 2011, Gweon et al. 2014, Jara-Ettinger et al. 2015, Legare 2012, Legare et al. 2010, Schulz & Bonawitz 2007). The motivation to understand unexpected outcomes guides children's exploratory play (Legare 2012). Exploration can generate evidence relevant to unconfounding variables (Cook et al. 2011, Schulz & Bonawitz 2007) and can improve learning (Bonawitz et al. 2012, Lillard et al. 2013). The process of generating an explanation improves understanding of causal mechanisms and relations and promotes generalization to novel contexts (Legare & Lombrozo 2014, Lombrozo 2006, Walker et al. 2014, Wellman 2011). The belief that children learn through active exploration is common in highly educated, industrialized populations (Gopnik 2016). Parents from educated, industrialized populations such as the United States encourage young children to participate directly in collaborative tasks, even at the expense of efficiency (Willard et al. 2019; J.M. Clegg, N.J. Wen, P. Harman, A. Alcott, E. Keltner & C.H. Legare, manuscript submitted).

The expectation that children learn by exploring the world around them, and should have the autonomy to do so, is common across diverse populations (Lancy 2016). For example, Inuit "parents do not presume to teach their children what they can as easily learn on their own" (Guemple 1979, p. 50). Okinawan parents put relatively few restrictions on their children's time, which they believe allows them to learn about daily activities (Maretzki & Maretzki 1963, p. 514). Ju/wasi hunters believe that learning to hunt is a process of doing (Lancy 2016). "Tracking…[cannot] be taught directly and much depends on the boy's ability to teach himself" (Liebenberg 1990, p. 70). In the ethnographic literature on children's learning, this belief is often based on the assumption

that children are motivated to learn culturally relevant skills to be helpful to others in their family and community (Gaskins & Paradise 2010, Howard 1970).

There is substantial cultural variation in the amount of autonomy children have to explore and the age at which they enroll in formal education. For example, children in foraging societies typically have a more extended period of freedom from social responsibility than children in agricultural societies (Hewlett et al. 2011; Kramer & Greaves 2011; Lancy 2016, 2017). One potential explanation for this is that the tasks relevant to hunting and gathering are too physically demanding for young children to contribute to and would thus reduce the efficiency of the activity; thus, their participation would increase the workload of others. In contrast, the tasks relevant to pastoral and farming communities are segmented into chores young children are capable of performing (Hames & Draper 2004).

Learning Through Observation

Children often learn in the context of social activities and practices involving cultural artifacts, technologies, and tools (Gauvain & Perez 2015, Lancy et al. 2010, Vygotsky 1962). Children acquire culturally specific skills and behavior by observing the daily activities of others in their environment. They are socially motivated to learn through observation to contribute to cooperative tasks (Gaskins & Paradise 2010). Children from diverse populations recognize others they interact with as intentional and cooperative agents, expect them to behave fairly, and coordinate their behavior accordingly (Blake et al. 2015). For example, children learn by watching adults or more able peers complete a task or attending to instruction directed at others, both inside and outside of formal educational environments (Rogoff 2003).

Learning through observation often occurs when "there is no intention to teach, and also when there is no intention to learn" (Gaskins & Paradise 2010, p. 87). This allows children to learn behavior without necessarily understanding, or needing to understand, why something is done in a particular way through the process of open attention. This is critical for the development of cultural learning because "the content to be learned is far broader than just physical skills and specific tasks; in fact, all kinds of knowledge can be acquired through observation, including language, social interaction behaviors, expressions of emotion, situational scripts, and even spiritual beliefs and other abstract knowledge" (Gaskins & Paradise 2010, p. 107). Observational learning allows children to acquire knowledge and skills through engagements with an expert and other apprentices during ongoing activity (Lave & Wenger 1991). Learning through observation also allows children to avoid making the mistakes of others, rather than through a potentially costly process of trial-and-error learning (Kendal et al. 2018).

Children's engagement in observational learning differs dramatically across cultures (Correa-Chávez & Rogoff 2009, Lancy 2016). For example, in Guatemalan Mayan culture, children are expected to pay careful attention when observing an activity, and explanations for the behavior are rarely provided (Rogoff et al. 1993). Children in Japan are also expected to learn by observational osmosis (*uchideshi*) (Azuma & Imada 1994). Children from non-Western cultural contexts, including Guatemala (Correa-Chávez & Rogoff 2009), Mexico (Gaskins & Paradise 2010), and Vanuatu (Clegg et al. 2017), display higher levels of attention in third-party contexts or situations in which an adult is giving instructions to another child than children from Western cultural contexts (such as the United States). For example, in a study conducted with pairs of siblings that assessed children's attention in a third-party context, children from Mayan communities displayed higher levels of attention while their sibling was doing a task and required less help whenever they had to complete the task themselves than US children (Correa-Chávez & Rogoff 2009). One potential explanation for cultural variation in observational learning is formal schooling.

Mexican-heritage mothers who had less formal schooling had children who paid keen attention to a task that was not addressed to them and were less likely to get distracted with surrounding objects than children of mothers with more formal schooling (Silva et al. 2010).

Learning Through Participation

In addition to providing opportunities for exploration and observation, caregivers, educators, siblings, and peers often provide children with opportunities to participate in ongoing activities (Alcalá et al. 2018). More-experienced adults and peers assist children in acquiring skills beyond their current abilities within a zone of proximal development (Vygotsky 1962). Children often learn the skills and practices of their communities through guided participation in cultural activities through a collaborative process (Rogoff 1990). Guided participation shapes children's learning in a variety of ways, including explanation and correction. It supports the process of complex skill acquisition, such as weaving (Greenfield 2004). An apprenticeship model of learning highlights the joint investment of children and their communities in the collaborative process of acquiring and transmitting cultural knowledge and skills (Gaskins & Paradise 2010).

Collaboration practices are diverse—they vary between populations—and flexible—they vary as a function of the learner (Rogoff 2003). For example, a cross-cultural study of parent-child collaboration in the United States and Vanuatu revealed that US caregivers encouraged children's firsthand participation in all task activities. Rather than completing the tasks themselves, US caregivers scaffolded children's direct involvement through a combination of nonverbal and verbal guidance. In contrast, Ni-Vanuatu caregivers' collaborative behavior reflected their belief that children learn through observation and should participate according to their skill level. Rather than the child directly completing the majority of the task activities, Ni-Vanuatu caregivers and children divided task activities through high levels of shared participation. Caregivers in both populations were sensitive to child factors, including age and task difficulty, and adjusted their behavior accordingly (J.M. Clegg, N.J. Wen, P. Harman, A. Alcott, E. Keltner & C.H. Legare, manuscript submitted).

Children actively request information from others during collaborative activity (Bjorklund et al. 2004, Callanan et al. 2007, Harris & Koenig 2006, Lancy 2008, Lave & Wenger 1991, Legare et al. 2017). For example, children request explanations from caregivers in the form of why questions (Callanan & Oakes 1992, Frazier et al. 2009, Gauvain et al. 2013, Harris & Koenig 2006, Solis & Callanan 2016). Children also become increasingly efficient at using questions to elicit useful and relevant information from others with age and experience, particularly in cultural contexts in which they are encouraged to do so (Mills et al. 2011, 2010; Ruggeri & Lombrozo 2015; Ruggeri et al. 2016). There is cultural variation, however, in the extent to which children are encouraged to ask questions. For example, children in Borneo are not encouraged to elicit instruction by asking questions or seeking explanations and instead are expected to learn through observation. Inuit children are expected to listen to the conversations of others but are not expected or encouraged to ask questions of adults (Lancy 2016).

Learning Through Imitation

The transmission of culture may be, in part, a product of our propensity for imitation (Vale et al. 2017). Imitation allows for horizontal transmission within generations and vertical transmission between generations (Heyes 2009, Schillinger et al. 2015, Tennie et al. 2009). Across cultures, children learn knowledge and skills by copying the behavior of trusted adults and older children (Corriveau et al. 2011, Harris 2006, Koenig & Harris 2005). Even infants have expectations for conformity (Powell & Spelke 2013) and are more likely to imitate in-group than out-group

members (Buttelmann et al. 2013). Copying the behavior of others allows children to learn skills and knowledge too complex to acquire through individual learning (Legare & Nielsen 2015). For example, there is growing evidence that although young children from diverse populations can rapidly learn to use tools to solve problems after observing their solutions, their capacity to engage in solitary innovation is strikingly poor in comparison (Berl & Hewlett 2015; Neldner et al. 2019, 2017; Nielsen & Tomaselli 2010; Nielsen et al. 2014).

Children often overimitate or copy actions that are not causally relevant to achieving a goal (Horner & Whiten 2005, Lyons et al. 2011, Rawlings et al. 2019). The proclivity to copy when uncertain is useful given that a large portion of human behavior is causally opaque—the underlying causal structure of behavior is unknown or unknowable (Legare & Souza 2012, Legare & Watson-Jones 2015). High-fidelity imitation is not merely an error in causal reasoning; instead, it allows for more efficient social learning than would be possible if copying required knowledge of the causal mechanism(s) underlying behavior or an event (Keupp et al. 2013, Toelch et al. 2014). Young children living in Western, urban populations (Clegg & Legare 2016b) and rural indigenous populations in southern Africa, northern Australia (Nielsen & Tomaselli 2010), and Melanesia (Clegg & Legare 2016a, Rawlings et al. 2019) engage in high-fidelity imitation. There is also between-population variation in imitative fidelity. For example, children in Vanuatu imitate with higher fidelity overall than children in the United States. One potential explanation for this is that expectations for conformity in Vanuatu are greater than in the United States (Clegg & Legare 2016a, Clegg et al. 2017), at least among adults (Wen et al. 2019).

Adults across a wide range of global populations view high-fidelity imitation as an efficient method of learning (Clegg et al. 2017) and a marker of intelligence (Harkness et al. 2007, McGillicuddy-DeLisi & Subramanian 1996, Serpell 1993). For example, the Swazi word for intelligence, *hlakaniphile*, is associated with the ability to successfully complete tasks after watching others complete them (Booth 2002). Caregivers in the United States also encourage children to engage in high-fidelity imitation (Clegg & Legare 2017). Taken together, these studies suggest a widespread and universal appreciation for the role of imitation in children's learning from caregivers.

Imitation may thus be an individual-level adaptation for learning the skills and practices of other group members (Tennie et al. 2009). According to the rational action theory of imitation (Buchsbaum et al. 2011, Gergely & Csibra 2006), several cognitive biases work in tandem to support high-fidelity imitation. Natural pedagogy, defined as interpretive biases to perceive ostensive communicative intent, facilitates information transmission (Csibra & Gergely 2009). A teleological stance, or proclivity to reason with the assumption of purpose, design, or function, enables young children to reason about objects and actions even when the underlying causal structure is opaque and the behavior appears to violate expectations for efficiency (Király et al. 2013).

Children have an early-developing capacity to flexibly adapt their use of high-fidelity imitation to different behaviors and contexts. This capacity allows children to be efficient cultural learners. Children's flexible use of imitation is driven by interpreting behavior as an instrumental versus a conventional act (Clegg & Legare 2016b, Herrmann et al. 2013). Children use imitation to acquire and transmit both instrumental (e.g., how to locate ripe fruit) and conventional (e.g., how to participate in a religious ceremony) knowledge, skills, and practices of the groups they are members of (Callaghan et al. 2011, Clegg & Legare 2016b, Hewlett & Roulette 2016, Legare et al. 2015). The demands of learning instrumental skills (i.e., object-related knowledge based in physical-causal rationales) and social conventions such as rituals (i.e., socially stipulated, causally opaque behaviors of groups) are different in a number of respects (Legare & Nielsen 2015, Legare et al. 2015).

Imitation and innovation work in tandem "as dual engines of cultural learning," deployed at different times for different purposes, to support learning instrumental skills and social conventions

(Legare & Nielsen 2015, p. 689). When one is imitating instrumental behavior, the objective is to produce the end goal. Identifying actions that are causally relevant to achieving the outcome provides an efficient means for accomplishing this (Legare et al. 2015). Learning the causal mechanism linking actions to outcome often results in lower-fidelity imitation. Knowledge of the causal system allows for variability in the reproduction of the behavior and, in some cases, the innovation of superior solutions. High-fidelity copying of instrumental behavior may be the result of a copy-when-uncertain social learning strategy (Rendell et al. 2011, Toelch et al. 2014). This strategy may be so useful for learning novel behaviors that the benefits outweigh potential efficiency costs (McGuigan et al. 2007). According to dual inheritance theory, natural selection would favor high-fidelity copying only if the environment was reliably uncertain or opaque (Richerson & Boyd 2005).

When imitating social conventions, the objective is to reproduce all the steps in the process with high fidelity (Call et al. 2005). This requires attending to the behavioral process. Imitating conventions has social functions, such as signaling affiliation with other group members (Legare et al. 2015, Over & Carpenter 2012, Watson-Jones & Legare 2016, Wen et al. 2016). Children's willingness to reliably imitate trusted others is based upon a motivation to form and maintain affiliation with group members and a desire to take part in group activities (Herrmann et al. 2013, Legare & Watson-Jones 2015, Legare et al. 2015, Over & Carpenter 2012, 2013). For example, they mimic gestural, postural, and intentional actions of older children and adults (Toren 2001). Young children are also selective about whom, when, and what they imitate (Kendal et al. 2018), and they attend to cues to prestige and status (Chudek et al. 2012, Henrich 2009).

Further evidence for the affiliative function of high-fidelity imitation comes from research on ostracism. Children imitate with higher fidelity when primed with ostracism (Over & Carpenter 2009, Watson-Jones et al. 2014). When ostracized by in-group members, children imitate group conventions with higher fidelity and display more anxiety than when ostracized by out-group members (Watson-Jones et al. 2016). This is consistent with research that motor mimicry of in-group members increases after social exclusion in adults (Chartrand & Lakin 2013, Essa et al. 2019). The results of these studies are consistent with the possibility that high-fidelity imitation functions as a reinclusion behavior in response to social exclusion by in-group members. Children may be particularly motivated to signal their commitment to a group following social exclusion by engaging in affiliative behavior (Watson-Jones & Legare 2016).

Instrumental and conventional behaviors have different objectives and functions, which have implications for both imitation and innovation (Legare & Nielsen 2015). For example, instrumental tasks can be completed in multiple ways as long as the desired outcome is achieved. When learning a new behavior with an instrumental goal, with an increase in experience, high-fidelity imitation will decrease and innovation will increase. In contrast, learning social conventions requires close conformity to the way others perform the actions and the outcome. When learning a new convention, imitative fidelity will stay high, regardless of experience, and innovation will stay low. Children in industrialized populations (e.g., the United States) and small-scale, subsistence populations (e.g., Vanuatu) imitate conventional tasks with higher fidelity than instrumental tasks when acting independently (Clegg et al. 2017, Legare et al. 2015). Children also transmit conventional behavior with higher fidelity than instrumental behavior when teaching a peer (Clegg & Legare 2016b).

Imitative fidelity increases over the course of childhood. There are age-related improvements in object memory-based imitation in early childhood (Rakoczy et al. 2009, Subiaul & Schilder 2014). Children also become more attentive to the social and contextual cues that distinguish instrumental from conventional behavior with experience (Clegg & Legare 2016b, Diesendruck & Markson 2011, Koymen et al. 2014, Legare et al. 2015). Imitative flexibility improves with age and is supported by caregiver socialization. For example, US caregivers encourage higher-fidelity

imitation of conventional than instrumental tasks. They provide more encouragement, demonstration, and monitoring when teaching their children conventional than instrumental behavior (Clegg & Legare 2017). They also encourage more creativity and innovation during instrumental than conventional tasks (Clegg & Legare 2017).

How do children differentiate instrumental from conventional behavior? Observation of action alone is often insufficient to identify the objective of a behavior. For example, lighting a candle could have an instrumental goal (lighting a dark room) or a conventional goal (worshiping a deity). From a young age, children attend to a variety of social and contextual cues to determine the goal of behavior (Buchsbaum et al. 2011, Carpenter et al. 2005). Children imitate behavior that is causally opaque with higher fidelity than behavior that has a transparent physical causal mechanism (Legare et al. 2015). They imitate behavior with multiple actors performing the same actions with higher fidelity than single actors, indicating sensitivity to consensus (Herrmann et al. 2013). Children imitate multiple actors performing the same actions at the same time with higher fidelity than multiple actors performing the same actions sequentially, indicating sensitivity to synchrony (Herrmann et al. 2013). Verbal cues to conventionality increase infants' (Scott & Henderson 2013) and children's imitative fidelity (Clegg & Legare 2016a,b; Legare et al. 2015).

Social and contextual cues to conventionality have several other consequences for behavior. For example, interpreting behavior as a convention increases attention to behavioral variation between actors. Children are more accurate at detecting differences between the behavior of two people when they interpret it as conventional rather than instrumental behavior. One possible explanation for this is that children expect conformity to social conventions, which motivates greater attention to detail and to procedural deviations (Legare et al. 2015).

The instrumental skills and social conventions children need to learn vary enormously within and between populations, which requires a cognitive system sufficiently flexible to acquire whatever cultural knowledge is locally relevant. Highly complex skills often require more than imitation to learn; they require instruction from more experienced and knowledgeable teachers.

Learning Through Instruction

The objective of child-rearing is to raise culturally competent children to adulthood (LeVine 2007). Caregivers, educators, more experienced adults, and peers interact with children in ways that increase the transmission of skills, practices, and knowledge within and across generations (Bjorklund et al. 2004, Cole 1996, Greenfield et al. 2003, Konner 2010, Lancy 2014, Otto & Keller 2014). Teaching is a change in behavior that is contingent upon or coordinated with the anticipated or expressed needs of a learner (Boyette & Hewlett 2017, Caro & Hauser 1992, Hewlett & Roulette 2016, Kline 2014, Strauss & Ziv 2012). Humans are likely unique among animals in their motivation to expend time and energy teaching others (Whiten 2017).

Adults expect children to learn from others and will assist when necessary (Kruger & Tomasello 1996). Teaching is the most cognitively sophisticated form of social learning because, to be most effective, the teacher and learner must take the perspectives of each other. Several psychological capacities support teaching. For example, metacognition, the awareness and understanding of one's thought processes; intersubjectivity, the ability to share psychological states and intent with others; and joint attention, the ability to engage in mutually recognized, shared focus, are all required for perspective taking to occur (Tomasello et al. 1993). The capacity to engage in coordinated and collaborative activity also supports effective teaching (Bass et al. 2018, Csibra & Gergely 2009, Marsh et al. 2009, Nielsen 2012, Shneidman & Woodward 2016, Tomasello et al. 2005, Ziv & Frye 2004, Ziv et al. 2016).

The ability to learn from adults is early developing (Csibra & Gergely 2009, 2011). Infants display behaviors and preferences that indicate a predisposition for learning from their caretakers. For example, they attend to adult faces, follow adult eye gaze, and imitate adult action (Meltzoff 1988, Moll & Tomasello 2004, Morton & Johnson 1991). Infants may interpret eye contact and vocalization followed by intentional behavior on the part of caregivers as conveying pedagogic intent (Gergely & Csibra 2006). Attentiveness to pedagogic intent facilitates acquiring information that cannot be learned readily through independent exploration (Kline 2014). Children who receive instruction from others engage in less exploration, perhaps because they assume that nothing else remains to be discovered (Bonawitz et al. 2011). Research in both the United States and Mexico (Yucatan Mayan) suggests that children recognize pedagogic intent early in development and that instruction reduces the amount they explore (Shneidman et al. 2016).

Teaching can facilitate the efficient transfer of information and is a universal feature of human cultural transmission (Legare 2017). Teaching practices vary based on the kind of information or skill to be learned as well as the amount of effort required on the part of the teacher (Kline 2014, Rogoff 2003). Kline (2014) developed a taxonomy (TEACH) to describe variation in kind, effort, and function of teaching practices. For example, teaching by social tolerance entails allowing a learner to have visual access to a focal activity for close observation. Teaching by opportunity provisioning entails allowing a learner to have physical access to activities that would otherwise be too difficult or dangerous for unmodified and unsupervised exploration. Teaching by evaluative feedback entails reinforcing the learner's behavior. Feedback can be negative or positive and can be verbal or physical via gesture or physical contact. Teaching by social or local enhancement entails directing the learner's attention toward the current activity. Direct active teaching is synonymous with didactic pedagogy. Teachers identify what is to be learned and make relevant aspects of the activity accessible. It can include direct or abstract communication, instruction, and demonstration.

Studying both continuity and variation in teaching frequency and kind across diverse populations deepens our understanding of the development of children's social learning (Lave & Wenger 1991, van Leeuwen et al. 2018) and cultural transmission (Legare 2017). The consensus within the psychological literature is that teaching is a natural and universal feature of human child-rearing (Csibra & Gergely 2009, 2011). There is less consensus within the anthropological literature; teaching is documented relatively infrequently outside of industrialized, formally educated populations (Lancy 2012, 2016). Nonverbal teaching behaviors, such as pointing and joint attention, have been documented in hunter-gatherer (Boyette & Hewlett 2017, Hewlett et al. 2011), subsistence agricultural (Kline et al. 2013, Little et al. 2016), and industrialized populations (Csibra & Gergely 2011, Hess et al. 1987).

There is between-population variation in other kinds of teaching behaviors, such as direct instruction and demonstration (Lancy 2012, Lave & Wenger 1991, Scribner & Cole 1973, Steward & Steward 1973). Potential explanations for the lack of consensus about the extent of cultural variation in teaching include how it has been defined (for a review, see Kline 2014) and the populations typically sampled in psychological versus anthropological research (Hewlett & Lamb 2005).

What explains variation in teaching practices within and between populations? Teaching behaviors vary in how effortful they are on the part of the teacher. For example, teaching practices such as opportunity provisioning and direct active instruction that require disruption, modification, or delay of ongoing behavior are costly in terms of time, effort, and resources. Costs and benefits of the mode of transmission in terms of time and resources, the cultural domain and complexity as well as learner, and teacher identity are all associated with variation in teaching style (Demps et al. 2012, Kline et al. 2013).

Expectations for how children learn also impact teaching behavior. For example, in Guatemala and Mexico, children are expected to learn via third-party observation of adult activity or by

close observation without being directly addressed or involved (Chavajay & Rogoff 2002, Mejía Arauz et al. 2007, Peck & Gregory 2005, Tobin et al. 2009). Caregiver expectations for children to learn through attentive observation before participating impact teaching style (Rogoff et al. 2003). For example, if caregivers expect children to learn through observation, they may use less direct active teaching (Kline 2014).

Variation in frequency and kind of teaching practices is associated with between- and within-population differences in economic, social, and educational institutions (see Legare 2017). Teaching varies as a function of the kind of information or skill to be learned, the effort required, beliefs about how children learn, and the kind of educational institutions used to transmit information (Kline 2014).

Outside the context of formal educational institutions, children learn through informal education or apprenticeship (Rogoff 2003). Informal education requires active participation in community activity and learning through observation (Paradise & Rogoff 2009). Teaching behaviors consistent with expectations that children learn by observing and actively participating are common in small-scale populations globally (Bird & Bliege Bird 2002, Gaskins & Paradise 2010, Odden & Rochat 2004). Populations without formal schooling may be less reliant upon direct instruction to educate their children (Childs & Greenfield 1980, Greenfield 2009, Greenfield & Lave 1982). In informal educational settings, caregivers engage in practices consistent with observational learning, such as teaching by social tolerance, teaching by social provisioning, and teaching by stimulus enhancement (Kline 2014).

Despite being a relatively recent innovation in cultural transmission, formal schooling has had a profound impact on teaching practices (Greenfield 2009) and on parent-child interaction (LeVine et al. 2012). Formal schooling segregates children from community activity (Lancy 2010, 2012; Rogoff 2003), typically segregates them based on age, and institutionalizes particular styles of instruction (Paradise & Rogoff 2009). Caregivers' beliefs about how children learn in formally educated populations reflect a hierarchical transmission of information from teacher to student (Childs & Greenfield 1980, Greenfield & Lave 1982, Scribner & Cole 1973).

Formal schooling is associated with direct active teaching, or the explicit verbal or physical presentation of information that emphasizes interchange between teachers and learners (Greenfield 2009, Kline 2014, Paradise & Rogoff 2009). For example, caregivers believe that adults are responsible for imparting knowledge to children (Odden & Rochat 2004) through the use of questions, instructions, and praise (Clark & Bernicot 2008; J.M. Clegg, N.J. Wen, P. Harman, A. Alcott, E. Keltner & C.H. Legare, manuscript submitted), explicit demonstration of behaviors (Little et al. 2016), and modification of tasks to make them more accessible (Hammond et al. 2012). Direct active teaching is common in formal educational institutions that prioritize using instruction to transmit abstract knowledge and skills such as literacy and numeracy. This style of teaching is so pervasive in industrialized populations that many of the current educational interventions call for reducing reliance on it due to concerns that it adversely impacts discovery, exploration, and creativity (Bonawitz et al. 2011). Teaching behavior is far more diverse than the direct active teaching emphasized in formally educated populations, however, and this explicit instruction is only one way that caregivers share knowledge with children (Greenfield 2009, Kline 2014).

Learning by instruction provides children with the opportunity to learn information too complex and abstract to discover on their own. Teaching is a universal feature of human child-rearing, a critical process by which children learn cumulative culture. Nonetheless, teaching practices vary in frequency and kind as a function of the kind of skill or knowledge being learned, the age and experience of the learner, and the kind of educational institutions of particular populations (Kline 2014, Rogoff 2003). Formal education has profound impacts on child socialization and learning (LeVine 2007). Educational institutions support the transmission of cultural technologies such

as literacy and numeracy, which make the accumulation, synthesis, and dissemination of cultural information possible.

In sum, a suite of learning capacities works in tandem to drive cultural learning (Legare 2017). Children learn through exploration, observation, collaboration, imitation, and instruction, yet the relative reliance on these processes varies within and between populations, as does the content of what children need to learn. For example, starting at age 7, Mayan girls in Guatemala learn to use the backstrap loom to weave fabric for clothing. Tannese girls in Vanuatu learn to garden and collect edible wild foods. Zulu girls in South Africa learn to collect water in gourds and carry them home by balancing them on their heads. The range of skills children are capable of acquiring is as diverse as the communities they inhabit. Culturally specific expectations for how children learn and their experience with the artifacts, technologies, and educational systems of particular cultural contexts impact the relative use and efficiency of these processes. Next, I review evidence for cultural variation in socialization practices and child-rearing values.

VARIATION IN SOCIALIZATION PRACTICES AND CHILD-REARING VALUES

Socialization practices and child-rearing values of particular communities impact cultural learning (Geary & Bjorklund 2000, Keller et al. 2005, Super & Harkness 1996). Populations vary in multiple ways that are relevant to socialization practices (Legare & Harris 2016, Nielsen et al. 2017). For example, in many populations around the world, rather than relying exclusively on parental caregivers, children are cared for by siblings, the extended family, and unrelated caretakers and educators (Lancy et al. 2010). Family size also varies dramatically between populations, which impacts opportunities for social interaction with familiar versus unfamiliar others. There is variation in the amount of time caregivers and children spend together and in the kinds of activities they do together (Cole 1996, Gaskins 2006, LeVine 2007). There is also variation in the extent to which children participate in adult economic and social activity (Keller 2007, Rogoff 2003). For example, by middle childhood, children living on Tanna, Vanuatu, a Melanesian archipelago in the South Pacific, are expected to assist adults in gathering, preparing, and cooking food; planting and harvesting crops; and childcare (J.M. Clegg, N.J. Wen, P. Harman, A. Alcott, E. Keltner & C.H. Legare, manuscript submitted).

Variation in socialization beliefs and practices is evident in caregiver-infant interaction (Broesch et al. 2016, Kärtner et al. 2016, Keller 2007, Keller & Kärtner 2013). Caregivers in different populations vary in how they respond to infants' emotional displays (Broesch et al. 2016, Kärtner et al. 2016) and how much they speak to them (Broesch & Bryant 2018, Cristia et al. 2019). There is also substantial variation in the verbal, vocal, and physical modalities caregivers use to communicate with infants (Keller et al. 2006). For example, a cross-cultural study of triadic interaction (caregiver-infant-object) in Vanuatu and the United States revealed that caregivers in Vanuatu use more physical contact during interactions with their infants, whereas caregivers in the United States use more eye contact (Little et al. 2016). This is consistent with ethnographic research that caregivers in many communities engage in more physical contact with infants than visual, face-to-face contact (Konner 2005, Little et al. 2016, Ochs & Schieffelin 2001, Richman et al. 1992). Variation in the modality of triadic interaction is associated with variation in caregivers' contingent responsiveness to infants' communicative signals (Kärtner 2015, Kärtner et al. 2010, Little et al. 2016). Research on cultural variation in the modality and contingency of caregiver-infant interaction is consequential because much of the theory in early socialization assumes that visually mediated joint attention and face-to-face communication, styles of social interaction most characteristic of industrialized populations, are critical for social learning (Harkness & Super 2002, Keller 2007, Lancy et al. 2010, Little et al. 2016).

Caregiver beliefs about how children learn vary substantially between populations, which impacts how caregivers interact with children and how children are educated (Keller 2007, Tobin et al. 2009). There is cultural variation in beliefs about children's capacity to learn through exploration and observational learning (Harkness & Super 2002, Keller 2007, Lancy 2016). Cultural models of socialization and education are behavioral templates for appropriate behavior and conduct (Lancy 2016, Quinn 2005) and have "directive force" because they guide behavior (Harkness et al. 1992, p. 170). According to Keller (2007, p. 105), "Nso villagers understood themselves as a collective with a strong opinion about what is right and wrong with respect to childrearing goals."

Formal education impacts child-rearing practices and values (Gaskins & Paradise 2010, Keller et al. 2006, Mejía Arauz et al. 2007), including how caregivers interact with their children (Kärtner et al. 2010), how they direct children's attention (Chavajay & Rogoff 1999, Silva et al. 2010), and how they use verbal instruction (LeVine et al. 2012). For example, urban German and Greek caregivers are more likely to instruct, engage, and stimulate infants than rural Cameroonian and Indian caregivers (Keller et al. 2009).

Taken together, a growing literature on infant and child socialization reveals substantial variation in caregiver-child contingency, modality, and activity between populations. Group-specific beliefs about how children learn, child-rearing values and practices, and educational institutions impact socialization.

SUMMARY

The variation and complexity of human culture are the results of cumulative culture, the processes of accumulating, modifying, recombining, and transmitting the beliefs, behaviors, and inventions of previous generations to create socially heritable bodies of knowledge (Henrich 2015). Many nonhuman species have culture, but none compare to the complexity and variation of cumulative culture characteristic of human populations (Dean et al. 2014, Whiten 2017). The flexibility and sociality of human cognition are a prerequisite for cumulative cultural learning (Legare 2017).

Children are well prepared to learn from others (Pun et al. 2018). Multiple cognitive processes structure and support social learning including cognitive flexibility, theory of mind, norm psychology, and prosociality. Social group cognition is early developing and impacts who children learn from and what they learn. Cultural learning processes support the acquisition of group-specific social norms over the course of ontogeny (Blake et al. 2015, House et al. 2013).

Children use a repertoire of cultural learning processes to acquire and transmit the diverse and complex knowledge of their communities. Children learn through active exploration, observation, and participation in collaboration with others. They use imitation flexibly to acquire the beliefs and behaviors of their groups (Legare & Nielsen 2015). Instruction allows for the efficient transfer of complex and abstract cultural knowledge and skills (Kline 2014, Legare 2017). Cultural values, socialization practices, educational institutions, and skill sets of diverse cultural and ecological contexts all impact teaching practices (Rogoff 2003). The development of cultural learning practices varies substantially in frequency and kind as a function of the values, skills, ecologies, institutions, and practices of particular populations. A comprehensive account of cumulative cultural learning requires a systematic study of variation in child-rearing values and practices (Nielsen et al. 2017). Socialization practices reflect different culturally specific child-rearing goals (Keller 2017, Lancy 2016).

Cross-cultural research on the development of cultural learning has enriched our understanding of cognitive and social development and substantially increased our understanding of the ontogenetic origins of a psychological hallmark of our species—cumulative culture (Legare 2017,

Legare & Harris 2016). The cultural contexts in which children live and learn are more diverse than the ecologies of any other species of juvenile organism, yet the vast majority of developmental psychological research is conducted among populations from Western, industrialized backgrounds (Henrich et al. 2010). For example, a recently published study on the cultural backgrounds of participants in scientific papers published in high-impact developmental psychology journals from 2006 to 2010 revealed that 91% come from Western, industrialized countries (Nielsen et al. 2017). Notably, only 4% of participants come from populations in Asian countries, and less than 2% come from participants from all African, Central, and South American countries combined. Within Western, industrialized countries, participants from Euro-American backgrounds are overrepresented in the research literature; participants from Latin-American, Asian-American, African-American, and Native-American backgrounds are underrepresented (Rowley & Camacho 2015). Across all countries studied, participants from higher socioeconomic backgrounds are overrepresented (Henrich et al. 2010). The dearth of empirical studies with diverse populations of children has significant implications for the scientific accuracy and generalizability of developmental psychological research (Apicella & Barrett 2016, Nielsen et al. 2017, Rowley & Camacho 2015).

Conducting research with children from industrialized populations living in environments with complex cultural technologies and artifacts provides unique opportunities to study the early-developing capacity to acquire, modify, and improve upon cumulative culture. However, populations from these cultural backgrounds are not representative of child-rearing environments globally or across our evolutionary history (Nielsen et al. 2017). The child-rearing values and practices of these populations have been shaped by historically recent educational and economic institutions (Rogoff 2003).

Despite growing evidence for cultural variation in all aspects of human cognition and behavior, most of this variation cannot currently be explained. Developmental research can provide unique insight into the processes by which cultural diversity emerges and changes within and between populations. Conducting research exclusively with adults cannot explain the source of cultural variation and change within and between populations. Constructing a veridical and complete understanding of the development of cognition and culture requires conducting social scientific research on the complex ecologies and child-rearing environments children live and learn in (Legare 2017).

Future research on cultural learning should examine how it changes over the life span and how it varies in a strategically selected set of cultural contexts that differ along theoretically relevant variables (Legare & Harris 2016, Legare & Nielsen 2015). Systematic comparisons within and between multiple groups that are similar in some ways but different in others have the potential to isolate particular variables as causal factors. Collecting observational, interview, and experimental data will yield a richer picture of cultural continuity and variation than has previously been documented. An interdisciplinary multimethod approach avoids the limitations of relying on a single method.

Cross-cultural research with children not only reveals the diverse and complex effects of the environment on behavior and cognition but also provides the empirical basis for evaluating claims about universal cognitive processes. Examining flexibility and variation in the development of cultural learning processes provides insight into the psychological foundations of cumulative culture.

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