Behavioral and Brain Sciences (forthcoming)

Children as agents of cultural adaptation

Authors: Sheina Lew-Levy[1] & Dorsa Amir*[2]

1. Durham University, Department of Psychology, Upper Mountjoy, South Rd, Durham DH1 3LE
2. Duke University, Department of Psychology & Neuroscience, Durham, NC USA

Email addresses: Dorsa Amir (dorsaamir@gmail.com | dorsa.amir@duke.edu), Sheina Lew-Levy (sheina.lew-levy@durham.ac.uk)

* Corresponding Author: Dorsa Amir (dorsaamir@gmail.com | dorsa.amir@duke.edu)

https://doi.org/10.1017/S0140525X24001377 Published online by Cambridge University Press

Short Abstract: In this paper, we argue that children play a more active role in cultural adaptation than previously recognized. We bring together convergent lines of evidence to suggest that children (approx. 3-17 years) invent, refine, and transmit knowledge in child-specific and independent *peer cultures*, which appear with regularity across diverse populations. These peer cultures play an important role in knowledge diversity and can help communities adapt to changing environmental conditions. As such, peer cultures — and children's roles, more generally — should be more seriously integrated into our understanding of human cultural evolution.

Long Abstract: The human capacity for culture is a key determinant of our success as a species. While much work has examined adults' abilities to create and transmit cultural knowledge, relatively less work has focused on the role of children (approx. 3-17 years) in this important process. In the cases where children are acknowledged, they are largely portrayed as *acquirers* of cultural knowledge from adults, rather than cultural producers in their own right. In this paper, we bring attention to the important role that children play in cultural adaptation by highlighting the structure, function, and ubiquity of the large body of knowledge produced and transmitted by children, known as *peer culture*. Supported by evidence from diverse disciplines, we argue that children are independent producers and maintainers of these autonomous cultures, which exist with regularity across diverse societies, and persist despite compounding threats. Critically, we argue peer cultures are a source of community knowledge diversity, encompassing both material and immaterial knowledge related to geography, ecology, subsistence, norms, and language. Through a number of case studies, we further argue that peer culture products and associated practices — including exploration, learning, and the retention of abandoned adult cultural traits — may help populations adapt to changing ecological and social conditions, contribute to community resilience, and even produce new cultural communities. We end by highlighting the pressing need for research to more carefully investigate children's roles as active agents in cultural adaptation.

Key words: human life history; cultural evolution; peer culture; child culture; cultural adaptation; cultural diversity.

Short Abstract: 90/100
Long Abstract: 234/250
Main text: 14,001

https://doi.org/10.1017/S0140525X24001377 Published online by Cambridge University Press

1. Introduction

The human capacity for culture is a key determinant of our success as a species. Several important behavioral adaptations, such as the ability to innovate, refine, and transmit new cultural products have enabled us to thrive in nearly every ecology on the planet, resulting in unparalleled cultural diversity and complexity. Our species' long childhoods also likely evolved to facilitate the learning and internalization of these complex cultural behaviors, underscoring the importance of childhood to the human success story. Yet, despite the clear importance of both development and culture to human flourishing, there is a tendency to characterize children primarily as *acquirers* of knowledge, vessels ready to be filled with adult culture. Here, we aim to challenge this view by highlighting the importance of children's *peer cultures* – the bodies of cultural knowledge created for and by children. We use "children" and "childhood" in this article as shorthand for the period of development preceding adulthood, between the ages of approximately three and seventeen years. Drawing on experimental and ethnographic studies in psychology, sociology, linguistics, folklore studies, anthropology, and archaeology, we argue that (i) children are independent producers and maintainers of autonomous cultures, (ii) peer cultures are a source of community knowledge diversity, and (iii) peer cultures may be called upon to help communities adapt to episodes of social and/or ecological change. Overall, we will show that the study of peer cultures can extend cultural evolutionary theory to better account for children's *active* role in processes of culture change.

Our paper is structured as follows: first, we briefly describe the basics of cultural evolution, and demonstrate that in this literature, children are routinely depicted as high fidelity-learners of adult cultures, rather than cultural producers in their own right. Next, we define what peer cultures are and describe how they fit into cultural evolutionary theory. Then, we flesh out our main arguments regarding the adaptive advantages that peer cultures may confer to communities. Finally, we highlight the paucity of investigations focused on peer cultures, and lay out important next steps for the study of children's cultures within human evolutionary research.

2. Current models of cultural evolution

Cultural evolution relies on several key components: (1) inheritance via *high-fidelity transmission* (Legare & Nielsen, 2015), (2) selection shaped by content and context *learning biases* (Henrich & McElreath, 2003; Price et al., 2017; Wood et al., 2013), and (3) variation introduced by *innovation* (Legare & Nielsen, 2015). Cultural traits are transmitted through mechanisms such as *teaching*—the modification of behavior to facilitate learning in another individual (Kline, 2015)—and *overimitation*—the copying of both relevant (i.e., causal) and irrelevant actions to achieve an instrumental goal (Lyons et al., 2007). Transmission pathways can take several forms, with cultural knowledge being shared vertically (from parents to

https://doi.org/10.1017/S0140525X24001377 Published online by Cambridge University Press

offspring), obliquely (from non-parental adults to children), and horizontally (from peer to peer) (Boyd & Richerson, 1985; Cavalli-Sforza & Feldman, 1981). New cultural products can arise through several innovation mechanisms (Galef, 2003), such as serendipity or accident, recombination of existing forms, or incremental improvement (Mesoudi et al., 2013). Some of these innovations might be goal-directed, in the sense that we might be attempting to solve a specific problem, while others are byproducts of exploration or copying error (Deffner & Kandler, 2019; Mesoudi, 2021).

Against this backdrop, developmental researchers have regarded childhood – defined here as encompassing early childhood (approx. 3-6 years), middle childhood (approx. 7-12 years), and adolescence (approx. 13-17 years) – as an important period for cultural learning. A large body of work on cultural evolution overwhelmingly portrays young children as exceptional *learners*, but poor innovators, as we outline below. We believe that these findings reflect an outsized focus on children's roles in cultural *acquisition*, with much less attention paid to their cultural *contributions*. As we will demonstrate, this portrayal is increasingly challenged by emerging research.

2.1. Children as learners

Cultural evolutionary studies regularly demonstrate just how good children are at learning: they pay demonstrable attention to subtle cues reflecting pedagogical intent (Gelman et al., 2013), such as pointing (Grassmann & Tomasello, 2010), eye gaze (Baldwin, 1991), and prosody (Bascandziev et al., 2022; Broesch & Bryant, 2015), alongside more overt teaching cues such as demonstration and direct instruction (Kline, 2015). For example, following a pedagogical demonstration of a new toy, 4-6-year-old children focused so exclusively on the target function demonstrated by an adult instructor that they did not discover the toy's other functions (Bonawitz et al., 2011). Further, children across cultures consistently *over*-imitate, even when irrelevant actions are obviously unnecessary (Clegg & Legare, 2016; Hoehl et al., 2019; Lyons et al., 2007; Nielsen & Tomaselli, 2010; Stengelin et al., 2019, 2020, but see Berl & Hewlett, 2015). Such high-fidelity learning—absent in other primates (Dean et al., 2014; van Leeuwen et al., 2018)—may have evolved to ensure that young humans understand the causal structure and function of complex tools and elaborate rituals, which are often too opaque to acquire through emulation alone (Csibra & Gergely, 2011; Tomasello, 2016).

Another popular line of inquiry into children's learning mechanisms has aimed to understand the biases in whom children prefer to learn from. In the absence of other cues (e.g., reliability; Jaswal & Neely, 2006), children display a relatively strong bias toward imitating adults (Taylor et al., 1991; Wood et al., 2012), presumably because age acts as a heuristic for expertise and/or because older individuals are more likely to have adopted adaptive behaviors (Deffner & McElreath, 2022; Wood et al., 2013). This age-related bias is evidenced across cultures, with

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British children preferentially imitating adults in instrumental domains (Wood et al., 2012) while Congolese BaYaka adolescent boys preferentially learn spear-hunting, an especially complex skill, from adult hunters (Lew-Levy, Milks, et al., 2021).

Importantly, children do not prefer to learn from adults in all domains. In fact, young children actually prefer to learn about toys, play, clothes, games, and food from peers (Kuczynski et al., 1987; Ryalls et al., 2000; Shutts et al., 2010; VanderBorght & Jaswal, 2009). Children also appear to be particularly good teachers: they facultatively adjust their instruction around learners' mistakes by five years of age (Ziv et al., 2016), and use generic language in pedagogical contexts to facilitate the learning of more general rules by age six (Gelman et al., 2013). Children are also adept peer learners, regulating their affect and increasing participation in response to pedagogical behavior (Howe et al., 2012; Howe & Recchia, 2005; Qiu & Moll, 2022). Studies of children, especially from a cross-cultural perspective, also reveal high levels of peer-to-peer teaching and learning (Lancy et al., 2010). While children do report that adults—and specifically, their parents—are the primary drivers of knowledge transmission (Kline et al., 2013; Lew-Levy, Ringen, et al., 2021; Schniter et al., 2015), experimental and observational research nonetheless suggests that peer teaching is widespread (Boyette & Hewlett, 2017; Lew-Levy et al., 2020; Maynard, 2002). Similarly, studies conducted in communities outside the post-industrialized West (Maya, Tsimane, NiVanuatu) show that the majority of linguistic input received in early childhood actually comes from other children (Cristia et al., 2019, 2023; Shneidman & Goldin-Meadow, 2012, see also Labov, 1964).

2.2. Children as innovators

Formal investigation into children's innovative capacities is relatively limited. The bulk of research examining children's innovation has tended to focus on the very specific domain of tool use, probing children's ability to innovate new tools, or use old tools in new ways (Beck et al., 2011; Carr et al., 2016). In a benchmark experiment known as the 'hook task', for example, children demonstrate their tool innovation abilities by bending a straight pipe cleaner into a hook to retrieve a prize from inside a long narrow tube (Beck et al., 2011). Children do not reliably innovate in the hook task until around eight years of age (Beck et al., 2011; Cutting et al., 2011). This has led many researchers to conclude that younger children are simply poor tool innovators. However, this conclusion may be premature: young children may struggle with tool innovation because it is an ill-structured problem—i.e., the steps between the start state and the end state are not clear (Cutting et al., 2011). It is also possible that tool innovation is more cognitively taxing, requiring coordination between causal reasoning, planning, and creativity (Rawlings, 2022), thus reducing young children's ability to succeed in this domain on their own. Thus, a diminished ability to innovate in the domain of tool use may not be reflective of a more domain-general inability to innovate.

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It is also important to note that most experimental studies on the development of tool innovation have tested children *individually*. However, recent work has revealed that children are more successful at innovation when problem-solving with their peers (Lancy, 2024, p.75). Gönül et al. (2019), for instance, found that peer interaction improved Turkish 5-6-year-old's performance in the hook task. Similarly, while Congolese BaYaka forager and Bandongo fisher-farmer children had low success rates in the hook task, they produced novel items during peer play with pipe cleaners (Lew-Levy, Pope, et al., 2021). And, in a micro-society experiment with groups of 3-4-year-olds, children invented and transmitted increasingly complex tools and tool use strategies to solve puzzle boxes (McGuigan et al., 2017). Overall, these studies suggest that children's tool innovations emerge *in groups* rather than individually.

In the linguistic domain, there is consistent evidence for children's innovative capacities (Cekaite, 2018). Young children not only repeat fragments of language they hear, but also create new sentences and phrases according to grammatical rules that are continually constructed and revised (Chomsky, 1976). Young children combine or modify words to fill gaps in their lexicon (Clark, 1982), reflecting high levels of lexical creativity. Children innovated a greater diversity of iconic signs—i.e., signs that directly resemble their referent—than adults in an experimental communication task (Lister et al., 2020). Further, in an experiment in which pairs of children were not allowed to communicate verbally, children invented new referential signs which became increasingly arbitrary, conventional, and grammatical over a 30-minute session (Bohn et al., 2019).

Finally, work in developmental cognitive science suggests that children are adept at exploration, a trait which may lead to the discovery of innovations. Theoretically, some have argued that childhood may have evolved as a solution to explore-exploit tensions, allowing for periods of 'high-temperature' exploration in early life followed by periods of 'low-temperature' exploitation in later life, a process referred to as 'simulated annealing' in the search and sampling literature (Gopnik, 2020). This developmental shift offers an important route through which local optima can be found and utilized. Empirical research tends to support this notion (e.g. Schulz et al., 2019). For example, using data from participants aged 5 to 55, Giron and colleagues (2023) demonstrate that human development resembles an optimization process of multiple learning parameters, with rapid changes occurring in childhood with a plateau and convergence toward efficiency in adulthood. These data suggest that children may be an important source of behavioral variation, able to produce novel 'local' solutions due to their unique exploration strategies.

2.3 A new perspective

The research reviewed above suggests that children and adolescents *can* and *do* transmit knowledge to their peers, and that their innovative capacities are enhanced by peer interaction.

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Yet, the image of children as learners-not-innovators overwhelmingly persists. We believe that this is largely due to the under-appreciation of an important component of the human cultural milieu: children's *peer cultures*. We contend that peer cultures might be the missing piece needed to make sense of children's active role in the processes of cultural maintenance and change. Specifically, we argue that children's peer cultures consist of autonomous cultural products that are largely distinct from those of adults (see **Figure 1**). Further, just as adults transmit knowledge to children, intergenerational transmission is likely *bidirectional*, in that children's cultural products feed into adult culture during rare but salient moments of culture change. Overall then, we believe that children's peer cultures may be an important contributor to cultural evolution more broadly. In the next section, we define precisely what we mean by peer cultures, and argue that despite being overlooked, existing research on peer cultures can help restructure our current understanding of the evolution of culture and human life history.

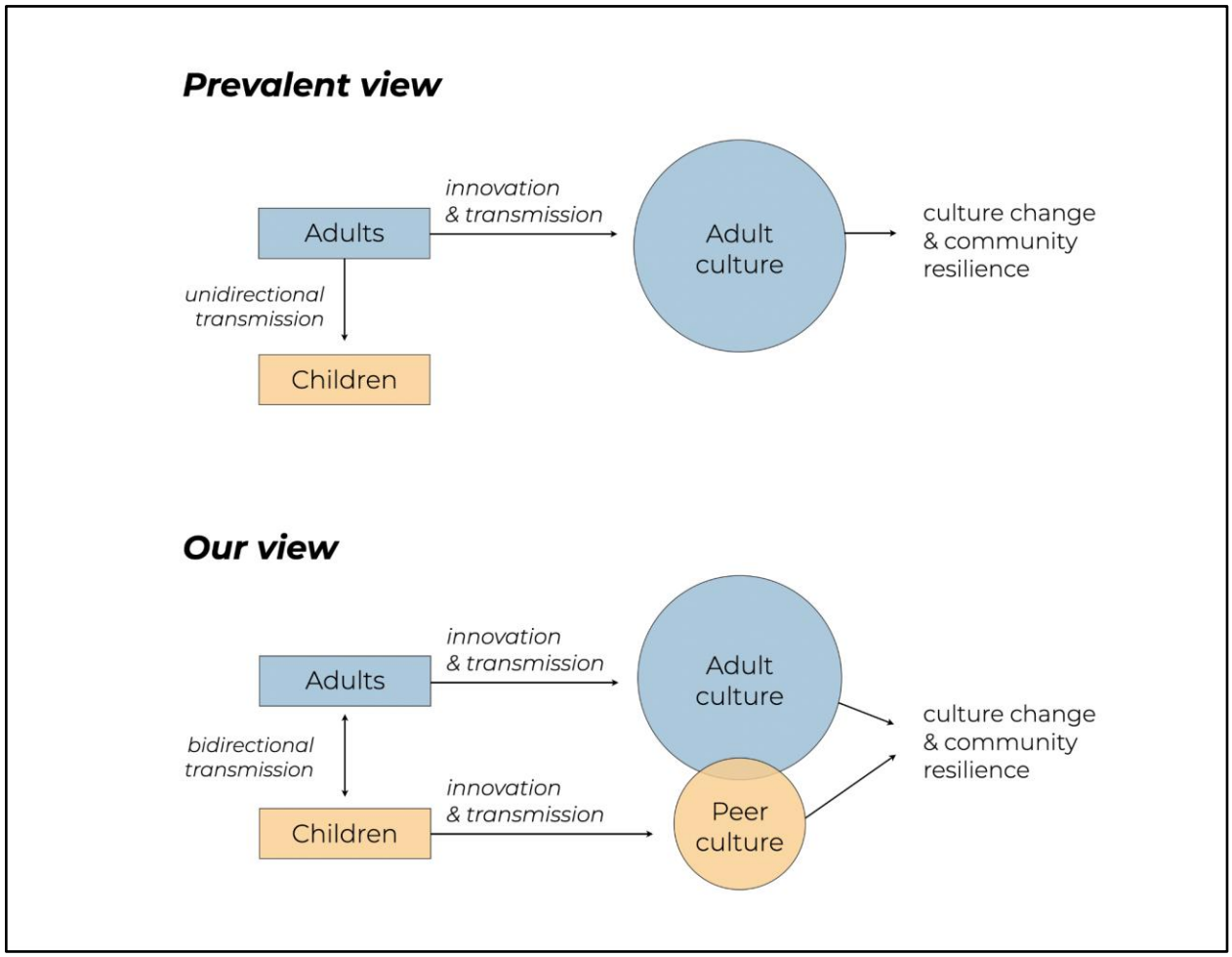

Figure 1: Contrasting views of adult and children's contributions to cultural evolution. The prevalent view (top) tends to consider adults at the center of cultural evolution, with transmission largely operating in one direction, from adults to children (Qiu & Moll, 2022), and adult culture as the engine of culture change and community resilience. Peer culture is largely absent or

https://doi.org/10.1017/S0140525X24001377 Published online by Cambridge University Press

ignored. Our refined view (bottom) suggests that children and adults maintain distinct cultures with bidirectional knowledge transmission. Cultures produced by *both* children and adults can contribute to culture change and community resilience.

3. What are peer cultures? An evolutionary overview

Peer cultures are the stable set of activities, artifacts, values, and concerns that children and adolescents produce and transmit in interaction with each other (Corsaro & Eder, 1990, p. 197). Peer cultures include playgroup games, rhymes, songs, and stories (Opie & Opie, 1998, 1959, 2013), norms for sharing and bartering food (Katriel, 1987), cures for common childhood ailments (Opie & Opie, 2013), supernatural beliefs (Winter, 2015), child-only subsistence strategies (Crittenden, 2016), and theories of contamination (Morin, 2008). Although there is some overlap between adult and peer culture, peer cultures are *not* merely a copy of adult cultures. Instead, when children do appropriate aspects of adult cultures, they usually reinterpret them to meet their own needs, such as adopting adult conflict resolution to solve disagreements arising during play (Corsaro, 1992).

3.1. The historical study of peer cultures

The first serious engagement with peer cultures was arguably done by anthropologist Edward B. Tylor in the mid-to-late 1800s. In his (now-outdated) work on the progressive complexity of culture over time, he suggested that children's cultures were vestiges of the "primitive" cultures that upper-class and Western adults had left behind (Tylor, 1871). Despite the inaccurate framework, Tylor was among the first to cross-culturally compare peer cultures. He argued that children's games often outlived "the serious practice of which it is an imitation" (p. 73), meaning children's practices persisted even when adult versions of those practices diminished. For example, he noted that while slingshots fell out of use by European adults during the middle ages, "the use of the rude old weapon is especially kept up by boys at play" (p. 73). The idea that children's cultures were simply a vestige of practices left over by adults remained a recurring theme in the decades that followed (Morin, 2015).

In the realm of behavioral science, when peer interactions have been studied, the focus tends to be on how these interactions influence *individual* development (Corsaro, 2017). In the behaviorist approach, children largely occupy a passive role in acquiring culture, with the peer group functioning to reinforce adult socialization practices (see Corsaro & Eder, 1990 for review). In the constructivist approach, best represented by Piaget (1947, 1968), children take a slightly more active role in organizing and using information from the environment in the process of acquiring adult skills and knowledge (Corsaro & Eder, 1990). Building on this

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perspective, Vygotsky's sociocultural theory emphasizes the central role of peer social interaction in child development, arguing that children scaffold and support each other's learning by guiding learners in their "zone[s] of proximal development" (Vygotsky & Cole, 1978), and that the peer group is critical for optimal social and cognitive development. However, even with a growing appreciation for peer interactions and socialization practices, the function of peer groups has historically been evaluated through the lens of future skill acquisition (Corsaro & Eder, 1990; Hirschfeld, 2002).

3.2. Conceptual, cultural, and logistical hurdles

While the work of anthropologists (e.g. Hirschfeld, 2002; Konner, 2010), sociologists (e.g. Corsaro, 1992), psychologists (e.g. Gauvain & Munroe, 2019; Lancy et al., 2010), and folklorists (e.g. Opie & Opie, 1959, 2013; Sutton-Smith et al., 2012) have made important headway in studying children's peer cultures as distinct cultural systems in their own right, this research agenda has remained largely outside of the purview of cultural evolutionary theory (see Morin, 2015 as a notable exception). In our view, this oversight reflects hurdles which, while not unique to cultural evolutionary theory, nonetheless have sidelined the more serious study of peer cultures in behavioral science.

First, human childhoods are significantly longer than those of other great apes, and are thought to have evolved as an extended period of time for learning the complex instrumental and social skills necessary to be a successful adult (Kaplan et al., 2000; but see Hawkes, 2003). Yet even in their youngest years, children play a consequential role in subsistence (Kramer, 2014; Lancy, 2015). Without Mayan children's contributions to family maintenance, for instance, parents would have to work two and a half times harder to meet their family's needs, representing unachievable workloads (Kramer, 2002; Lee & Kramer, 2002). Sibling care and peer group socialization are also important mechanisms through which children free parents to perform more high-skill and high-strength tasks (Kramer & Veile, 2018; Page et al., 2021; Weisner et al., 1977). Further, the availability of siblings and peers makes horizontal learning especially convenient (Reyes-García et al., 2016). These findings compel us not *only* to consider children's individual learning for their future adulthood, but also the immediate benefits that children's peer group subsistence and educational activities may confer to themselves, their families, and their communities.

Next, and despite efforts to diversify participant study communities, evolutionary researchers themselves remain primarily of European descent (IJzerman et al., 2021), often bringing with them implicit and unexamined ethnotheories regarding childhood learning. This is particularly relevant for the study of peer cultures as research reveals that in post-industrialized Euro-American countries, children have fewer opportunities to assort independently (Lancy & Grove, 2011). This is because children's play is quickly succumbing to adult-made forms of

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entertainment (Morin, 2015), and because children are increasingly losing access to physical 'third spaces' where they can interact outside the purview of adults (Singer et al., 2009). Thus, from the point of view of Euro-American scholars, peer cultures may seem rare or inconsequential, or relegated entirely to the domain of play. In contrast, scholars from the Global South regularly highlight the centrality of children, their peers, and peer cultures to cultural development. Notably, Nsamenang's theory of Social Ontogenesis (Nsamenang, 2015), drawn from his research with the Nso in Cameroon alongside his own life experience as a member of this community, posits that human development is (p. 841-842) "partly determined by the social ecology in which the development occurs and by how African children, especially in sibling and peer settings, learn from each other in peer cultures," and "less through explicit adult instruction or prodding." Incorporating these perspectives into mainstream cultural evolutionary research can help refine and improve our theoretical frameworks.

Finally, researchers working on the evolution of cultural learning overwhelmingly tend to collect data over short timespans (McElreath & Koster, 2024), an understandable byproduct of the financial and logistical challenges of field-based developmental research. In experiments, this can be as short as a few minutes; in observational research, time is measured in days, or rarely, months; for some lucky few, longitudinal research can span a few years. Only in very rare cases have researchers tracked changes in childhood activities over generations (Greenfield et al., 2000; Lancy, 2015; Pollom et al., 2020). Yet, as we will show in section 6, a handful of studies suggest that children's activities may have disproportionate effects on community adaptation during episodes of profound social, cultural, and ecological change. In other words, at short time scales, the importance of children, their activities, and their peer cultures may be easily overlooked, despite their importance during rare but salient community-level events that can occur across longer timespans.

In sum, there are likely a number of reasons for the paucity of evolutionary work on peer cultures. In the next two sections, however, we contend that the little we *do* know has much to offer the study of cultural evolution, and relatedly, human life history theory.

3.3. Peer cultures in cultural evolutionary theory

While we canonically think of invention as a single person discovering a new idea ("Eureka!"), it is increasingly recognized that innovations are emergent features of groups (Galesic et al., 2023; Muthukrishna & Henrich, 2016; Whiten et al., 2021). Three features in particular play an important role in innovation frequency (Muthukrishna & Henrich, 2016). First, innovations are more likely to happen in larger populations: more people means more opportunity to learn from the most skilled (Henrich, 2004; Kline & Boyd, 2010). Second, a higher individual rate of fidelity increases mean cultural complexity by ensuring that new innovations are accurately acquired, maintained, and transmitted across generations (Csibra & Gergely, 2011). Third, higher

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cultural trait diversity can result in a greater variety of techniques and approaches, some of which may be improvements (Collard et al., 2013). Transecting all three features, network connectivity also plays a role (Pablo et al., 2022; Smaldino et al., 2024; Smolla & Akçay, 2019), with partially connected networks allowing for diversity, leading to cumulative improvements through recombination (Derex & Boyd, 2016).

Crucially for our argument, peer cultures evidence all of these features. As members of both peer and adult cultures, children are maximally social, having ample opportunities to recombine information from multiple (child and adult) sources to produce innovations. As we outlined previously, children are not only effective at learning from adults, but also proficient at teaching, and learning from, their peers (Lew-Levy et al., 2023). The knowledge and know-how produced by peer groups is also distinct from that of adults, representing an important source of cultural trait diversity (Pretelli et al., 2024). Finally, peer cultures are autonomous yet partially connected to adult cultures, with occasional (unidirectional) migration as children grow up and leave peer cultures behind. Thus, theoretically, peer cultures may be an adaptive feature of human social organization which bolsters population-level innovation capacity.

As a source of possible solutions for the community as a whole, peer cultures may enable "faster collective adaptation in times of quick, significant changes" (Galesic et al., 2023, p. 9). Indeed, Fogarty and Kandler (2020) show that existing cultural variance—what they call 'standing variation'—confers a greater adaptive benefit than new innovations during environmental shifts. This is because a trait that is potentially adaptive for a new environment may already be relatively widespread in the population, facilitating further spread. With foresight towards potential future environmental change, populations can promote cultural variance by maintaining the existence of older traits – an inherent feature of peer cultures (see section 5.6). Some agent-based models have further suggested that behavioral variants introduced by children are especially adaptive in rapidly changing environments. Deffner and McElreath (2022), for instance, found that a copy-the-young strategy was advantageous in fluctuating environments as a middle ground between social learning and innovation, allowing younger individuals to update their behaviors to their current environment. Similarly, Acerbi and Parisi (2006) showed that, because peers are imperfect teachers who have not yet completed their own learning (see also Deffner & Kandler, 2019), horizontal transmission can add the variability required for cultural evolution to take place. The positive role for such intra-generational transmission is amplified in rapidly changing environments, where new behaviors more suitable to the new environment are needed. Considering that, by definition, peer cultures represent a corpus of horizontally transmitted knowledge, they may represent an important source of adaptive variation.

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3.4. Peer cultures in human life history theory

As noted, much research on the evolution of long human childhoods has focused on eventual adulthood. Yet, for children to reach adulthood, they must first learn to navigate the niche of childhood (Bjorklund & Green, 1992). Considering that our genus *Homo* evolved against a backdrop of rapidly changing and unpredictable environmental conditions (Potts, 1998), knowledge that was socially acquired from adults may not have always remained relevant when children themselves reached adulthood. Exploration — both individually and in peer groups — may have allowed children to more accurately track environmental circumstances, perhaps better than social learning alone would afford (Gopnik, 2020). Experimental evidence indeed suggests that children possess unique cognitive features that can enable this form of exploration. Younger children, for instance, are better able than adults to infer unlikely hypotheses in instrumental and social experimental tasks (Seiver et al., 2013; Wente et al., 2019). Adolescents are also more likely than adults to infer unlikely causal relations in social domains (Gopnik et al., 2017).

Several social features inherent to childhood may further bolster children's exploration (Gauvain & Munroe, 2019). Children are cared for and provisioned by community members (Hrdy, 2011), affording them extensive opportunity for creative exploration (Greenbaum et al., 2019). Much of this time is spent in play, primarily social play, which offers an intrinsic motivation to explore one's environment, and which is strongly linked with creativity and innovation (Bateson, 2015; Carr et al., 2016). More goal-directed problem solving may emerge in adolescence, when children have developed enhanced capacities for abstract reasoning, creative thought, and risk-taking (Crone & Dahl, 2012; B. Hewlett, 2021). Importantly, exploration need not occur individually. From the age of two onwards, children are increasingly peer-focused (Eckerman et al., 1975). Through collaborative exploration, peer interaction can be generative, leading to the discovery of information not initially possessed by either child (Gauvain & Munroe, 2019; Phelps & Damon, 1989). Indeed, educational researchers have demonstrated that peer collaboration and peer tutoring confer benefits to learning in domains including mathematical concepts, Piagetian conservation tasks, moral reasoning, spatial navigation, and instrumental problem solving (Ames & Murray, 1982; Ashley & Tomasello, 1998; Emler & Valiant, 1982; Kruger, 1992; Phelps & Damon, 1989). Through feedback and debate in an atmosphere of mutual respect, children can coordinate their perspectives to abandon misconceptions, creatively search for better solutions, and generate new ideas (Damon, 1984). Together, these features suggest that childhood is not only a time for exploration, but one for exploring *with peers*, potentially leading to the discovery of useful innovations.

In summary, peer cultures may represent an important source of behavioral variation which may be especially adaptive during periods of environmental fluctuation. Further, the evolution of childhood may reflect a careful balance between explore-exploit trade-offs to better track potential environmental changes. Such early-life exploration may be bolstered by peer group interaction. Overall, these theoretical perspectives compel us to more seriously consider whether

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peer cultures can drive cultural evolution. In sections 4-6, we review the empirical evidence for this proposition. In section 7, we discuss open empirical questions at the intersection of peer cultures, cultural evolution, and life history theory.

4. Peer cultures are distinct from adult cultures

In this section, we provide evidence that children are producers and maintainers of their own autonomous (i.e., self-governed) cultures. We draw largely on qualitative research from sociocultural anthropology, sociology, and folklore studies, supplemented by examples from the ethnographic canon, to support our arguments. Notably, we consider the possibility that children's peer cultures exhibit distinct transmission mechanisms which overcome specific threats to their proliferation.

4.1. Peer cultures are autonomous

Peer cultures exhibit high levels of autonomous governance. Indeed, the active exclusion of and resistance to adult input appears to be a recurring feature of peer cultures (Corsaro, 1988; Corsaro & Eder, 1990; Opie & Opie, 1959; Robinson & Corsaro, 1987). In his ethnographic work on Melanesian children in the Trobriand Islands, for instance, anthropologist Bronisław Malinowski describes how the "small republic" of children "acts very much as is its own members determine, standing often in a sort of collective opposition to its elders" (1929, p. 53). Iona and Peter Opie similarly describe British children's cultural products, such as schoolyard rhymes, as "not intended for adult ears… in fact, part of their fun is the thought, usually correct, that adults know nothing about them" (1959, p. 1). More generally, in children's folklore studies, researchers are relatively unanimous in their observations that adult contributions to children's peer culture are either minimal or nonexistent (Fine, 1980; Morin, 2015; Newell, 1883; Opie & Opie, 1959). In addition to the active exclusion of adults from peer cultures, children's peer culture, especially as it matures into adolescence, bears some resemblance to other forms of counter-culture (Corsaro & Eder, 1990), often containing subversive messages about resistance to adult power (Ackerley, 2007; Sutton-Smith, 1997).

Around the second year of life, forager children begin to spend the majority of their time with peers in mixed-age and mixed-gender playgroups (Konner, 1976, 2017; Lew-Levy et al., 2018). Within these playgroups, children receive relatively little adult intervention and minimal supervision (Crittenden, 2016; B. S. Hewlett, 1992; Naveh, 2014). For instance, in contemporary surveys of forager-horticulturalist Tsimane in Bolivia, most parents state they often don't know exactly where their children are (though they do tend to know where they *aren't)* (Davis & Cashdan, 2020). Malinowski also describes the "considerable freedom and independence" of the "republic of children" in the Trobriand Islands (1929, p. 45):

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> "Such freedom gives scope for the formation of the children's own little community, an independent group, into which they drop naturally from the age of four or five and continue until puberty… If the children make up their minds to do a certain thing, to go for a day's expedition, for instance, the grown-ups and even the chief himself, as I often observed, will not be able to stop them… Their spiritual ownership in games and childish activities was acknowledged, and they were also quite capable of instructing me and explaining the intricacies of their play or enterprise."

Margaret Mead's ethnographic work among Samoan children uncovered similar trends; she observed "the development of a group which played continually together and maintained a fairly coherent hostility toward outsiders" (Mead, 1928, p. 61). And, adults in these communities, it appeared, largely ignored children from birth until they were roughly around sixteen years old (Mead, 1928).

Across time and disparate cultures, convergent lines of evidence also suggest that children have a preference for *physically* segregating their play spaces from adult spaces. This remains true even in post-industrial societies. Iona and Peter Opie (1959) describe World War II bomb sites as the preferred play location for British children, who used the space to play hide-and-seek, make fires, and cook potatoes. As landscape architect Kylin (2003) further observed, Swedish children preferred to build playhouses in locations that were hard to find, providing privacy away from their parents. In subsistence societies, play camps and play villages are also typically built by children on the edges of adult settlements (Hardenberg, 2010). This pattern is also clear in archaeological examinations of children's play spaces (Nowell, 2021): remnants of Thule children's playhouses in Greenland, for example, showed that they were often separated from the actual community settlement, far enough away to allow for undisturbed play without interference from adults (Hardenberg, 2010). In addition to evidencing physical segregation, playhouses also exemplify how children appropriate adult cultural products to assert peer group independence.

In another manifestation of autonomy, children appear to be highly capable of regulating their own activities. Young children frequently develop new rules of social engagement and strategically utilize language to regulate the behavior of their peers in order to create membership categories to include or exclude others, in addition to constructing other components of their own social order (Cobb-Moore et al., 2009). Hierarchies regularly rise and fall, relationships evolve, and alliances are formed and broken, all outside the purview of adult engagement or regulation (Danby, 2002; Lancy et al., 2010; Robinson & Corsaro, 1987). Within their social orders, children negotiate participatory rights (Corsaro, 2003), and sometimes fall into territorial conflicts (Corsaro, 2017) resolved through peer participation. They also ritualize many aspects of their sharing behavior (Katriel, 1985, 1988), such as the sharing of secrets (Katriel, 1990) and valued items (Katriel, 1988).

4.2. Peer cultures are transmitted

In their work with British schoolchildren, Iona and Peter Opie's meticulous observations demonstrate how peer cultural traits circulate "from child to child, usually outside the home, and beyond the influence of the family circle" (1959, p. 1). The transmission pathways found in peer culture also demonstrate several unique features. First, peer cultures evidence what cultural evolutionary researcher Morin (2015) calls *quasi-horizontal transmission*, from older to younger children. Piaget's own work with children provides a clear example of this form of transmission: "The rules of marble games are handed down… from one generation to another…The little boys who are beginning to play are gradually trained by the older ones in respect for the law" (Piaget, 1948, p. 2).

Further, while all populations have some rate of turnover as individuals reach the end of their lifespan (i.e., demographic renewal), peer cultures have exceedingly high rates of turnover since the demographic renewal is not determined by total lifespan, but by the amount of time spent as children (Morin, 2015). To survive in the face of this time pressure, peer culture must quickly proliferate through frequent transmission to each successive wave of new children. Peer cultures are also transmitted along long, compact, and narrow diffusion chains (Morin, 2015, p. 186)—or webs (Robert Boyd, personal communication)—as a single child only has direct access to a tiny fraction of the full peer population. As a result, peer culture traits must go through a large number of relays to be widely diffused (Morin, 2015). Given the high rate of turnover, a peer cultural product—such as a schoolyard rhyme—that persists over 100 years is roughly equivalent to an adult cultural product persisting through half a millennia of oral transmission (Morin, 2015; Opie & Opie, 1959).

Despite these threats to transmission, peer cultures spread rapidly and with surprisingly high fidelity. Iona and Peter Opie argue that one of the most remarkable features of peer culture is "how comparatively little it alters considering the usage it receives" (1959, p. 11):

> "[Adult-propagated cultural products for children, such as nursery rhymes are] not usually passed on again until the listener has grown up and has children of his own, or even grandchildren. The period between learning a nursery rhyme and transmitting it may be anything from twenty to seventy years. With the [child-propagated cultural products such as] playground lore, however, a rhyme may be excitedly passed on within the very hour it is learnt; and in general, it passes between children who are the same age, or nearly so… If, therefore, a playground rhyme can be shown to have been current for a hundred years, or even just for fifty, it follows that it has been transmitted over and over again; very possibly it has passed along a chain of two or three hundred young hearers

https://doi.org/10.1017/S0140525X24001377 Published online by Cambridge University Press

and tellers, and the wonder is that it remains alive after so much handling, let alone that it bears resemblance to the original wording."

What features promote the transmission of peer cultural traits? In the realm of folklore, Iona and Peter Opie suggest that there must be some "art and rhythm" to playground chants that are engaging enough to "hold on a child's mind, although what exactly the quality is which gives some verses immortality is difficult to discover" (1959, p. 13). In this vein, Morin has examined various hypotheses that may explain the remarkable stability and endurance of peer culture folklore across time (Morin, 2015). One hypothesis is that children's traditions exist because children are particularly good copiers with a strong preference for high-fidelity imitation (Baucomont et al., 1961; Opie & Opie, 1959). While it is true that children are conservative imitators, this desire to coordinate would only predict that cultural forms are copied with high fidelity, and not that they diffuse rapidly or are widely adopted. Another hypothesis is that children's cultural traits—such as schoolyard songs—diffuse widely because they appeal in various ways to our minds, such as through memorability (Rubin, 1995) or rhyme and assonance (Opie, 2018). Morin (2015), however, argues that while it is possible that memorability causes the proliferation of certain rhymes, it could also plausibly work the other way: some rhymes may be remembered *because* they were repeated so frequently. The mechanism may thus be selection for proliferation, itself: the cultural forms that survive are those that can elicit frequent repetition.

4.3. Peer cultures vary over time and space

Children regularly engage in the playful creation of new cultural forms which exhibit variation across time and space. In the 1950s, for example, slang words for money among British children included: brass, lolly, tin, dough, mazuma, moolah, dosh, sploosh, bees and honey, and champagne coupons (Opie & Opie, 1959), with new words continually and regularly generated. These innovations, if favored, were quickly integrated into children's cultural repertoires (Meckley, 1994). In addition to explicit invention, traits like novel words can arise through memory errors or mishearing, yet others from creative play with the pace, speed, and shortening of phrases. At a Surrey school, for instance, the pledge "Cub's honour" became "cub's-on-a-car", which was subsequently abridged to simply "car" (Opie & Opie, 1959).

Peer cultures are also responsive to contemporary social themes, figures, and artifacts, reflecting and remixing aspects of an ever-changing popular culture. For instance, much of British schoolchildren's peer lore, rhymes, and games revolved around popular celebrities (Opie & Opie, 1959). Bandongo fisher-farmer children in the Republic of the Congo, meanwhile, manufacture toy cars out of sticks and discarded flip flops, an activity transmitted exclusively within the peer group (Figure 2). This is despite the fact that no roads or cars reach their village, and young children rarely travel to villages with road access.

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Figure 3: Bandongo boys and girls (Likouala Department, Republic of the Congo) manufacture toy cars from sticks and discarded flip flops. This activity is transmitted solely within the peer group. Photo by Sarah Pope-Caldwell in 2018, shared with permission.

Peer culture traits wax and wane in popularity, reflecting contextual forces. For instance, games historically associated with girls, such as singing games, cooperative parlor games, and kissing games became less popular over time (Sutton-Smith & Rosenberg, 1961), potentially reflecting shifts in gender norms and childhood autonomy (see also Van Rheenen, 2012). Evidencing peer culture autonomy, games known to and promoted by adults seem to *decline* in popularity, whereas games considered by adults as difficult (skipping rope) or dangerous (knife throwing) remain popular (Opie & Opie, 2013). As games become more popular, they often become more complex. Popular games attract additional rules and formalities, taking longer to complete, and requiring more skill (Opie & Opie, 2013). Games in decline may be simplified, or broken apart, with fragments being adopted into other games.

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Peer cultures also exhibit regional diversity. Children's stories and urban legends, for example, while widespread, tend to be spatially localized to one's own town: "a haunted house is not just any house, but a house in the child's own neighborhood" (Fine, 1980, p. 182). Children in multicultural communities also exhibit more diverse peer culture traits. According to Iona and Peter Opie, Scottish children "know most of the English children's rhymes [...] and they also have their own […] rarely known to children outside Scotland" (Opie & Opie, 1959, p. 26). Immigration further diversifies peer cultures. In Australia, for instance, peer cultures have expanded to include rock and pebble games introduced by children of Sudanese origin (Darian-Smith & Pascoe Leahy, 2013).

5. Peer cultures maintain distinct knowledge

In the previous section, we outlined the processes of transmission, variation, and innovation which give rise to autonomous peer cultures. We now focus on the distinct peer culture *content* produced by these processes; that is, the products themselves. Historically, and certainly in the emergent field of anthropology, it has been customary to view children's peer group activities as strictly imitative of adult culture (Sutton-Smith, 1984). Convergent lines of evidence, however, suggest that peer cultures contain unique traits not usually found in adult culture. In this section, we will provide rich and varied examples of children's distinct knowledge that arise not only through innovation, but also through the maintenance of cultural traits abandoned by adults.

5.1. Geographic knowledge

Within their peer group (and when given the opportunity), children are frequently motivated to explore their surroundings, especially those at the margins of adult use. Among Central African Aka, for instance, nearly three quarters of children's forest play was done out of sight from adults (Boyette, 2016). Terashima (2016) argues that such roaming play instigates careful attention to and interaction with the natural world, leading to discovery, and ultimately, the creation of new ideas and technologies. Such roaming can also lead to the appropriation of liminal spaces. In the Dominican Republic, for example, informal settlements have been established along *cañadas*, or narrow streams, in the Santo Domingo metropolitan area (Sletto & Diaz, 2015), where they often serve as waste sites. Due to the risk of pollution and contamination, parents often warn their children about the dangers of the *cañadas*. This, however, does not impede children, who regularly explore and play in the *cañadas*, sailing toy boats and digging for 'magic rocks'. Through these activities, "children appropriate and re-construct the meaning of liminality associated with these informal geographies," leading to children's unique place-making (Sletto & Diaz, 2015, p. 1693).

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Similarly, in a study of American children's engagement with a nearby forest, Blizard and Schuster (2004) found that children had rich oral histories and traditions associated with the space, such as named places ("The Shady Glade, The Herb Field", The Teeter-Totter Tree"), "an extensive knowledge of actual and/or imagined place history" (p. 58), an entire currency system based on pine cones, novel methods for creating natural dyes from local berries, architectural achievements such as stone pathways, and ever-expanding forts. These histories and traditions shared virtually no overlap with adult culture. In addition to aiding coordination, shared mental maps and place names—cultural products sometimes referred to as "topographical gossip" (Lewis, 1976)—serve important functions. Taken together, they comprise a socio-cultural system of navigation that is independent of formalized latitude-longitude grids, and bear structural similarity to the many navigation systems found among adults from small-scale societies (Widlok, 1997). These practices may also bolster children's visual spatial memory, as evidenced in a comparison of Australian Aboriginal children's navigation skills versus those of white Australians (Kearins, 1981).

5.2. Ecological knowledge

Around the world, children have their own vocabulary and use for plants and animals. Among the Eastern Apache in the late 19th century (Opler, 1996, p. 41):

> "Many a child has learned to braid with wild iris, candy grass, or clover. Little girls pass the time pleasantly making a long string of the leaves of *Dalea dalea* and then arranging it in several strands with leaves interlocking. From the virgin's bower plant and a species of aster the children obtain toy hats, and Vicia is employed as a dancing robe. The four-leafed clover is considered lucky, and the children have contests to see who can find one first. They blow into the choisey flower to make a sound that is likened to the call of the fawn. The name of the plant is, accordingly, "that which cries like a deer's child." Beard-tongue buds are picked and popped. "Bird tracks" are made in the sand with Bermuda grass, and a leaf transfixed to Bermuda grass "feet" is called a bird."

Much of this ecological knowledge is unknown to adults. For example, when Gallois and colleagues (2017) surveyed Cameroonian Baka, the authors found that some ecological knowledge related to small mammals and birds reported by Baka children was not reported by adults. When asked about the discrepancy, adults claimed to be unaware of many of the items children listed: "Children have their own knowledge about mice. They are always inventing new names!" (p. 73). Adults also argued that mice and small birds were child-specific resources. Further, some of the animal names provided by Baka children were linguistically close to other languages, such as those spoken by their Nzime farmer neighbors. This suggests that children are actively fostering knowledge exchange with other communities through their peer group activities. Similarly, Betsileo children from Madagascar report different wild edible plant species

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than adults (Porcher et al., 2022). Interestingly, "children cited more introduced species as salient than adults" (p. 10), reflecting the possibility that children's exploration may allow them to better track ecological change, and generate up-to-date ecological knowledge.

5.3. Material culture

Children regularly make and use material culture inexistant in adult culture. In the Congo Basin, for instance, BaYaka children manufacture sling shots by harvesting rubber from rubber vines (Lew-Levy, personal observation). These are used to hunt songbirds, species not targeted by adults. Among the Hadza in Tanzania, Crittenden (2016) reports that children make seasonally specific sticky traps for catching weaver birds, sometimes eating them, other times using their feathers for ornamentation. Among the Baka (Dounias, 2016, p. 9):

> "Kids are depositories of a specific sphere of trapping knowledge, which is technically speaking the most diversified, and which they manage on their own. The intervention of adults is minimal since this form of trapping takes place in proximity of the safe homestead. The assembling of these traps combines recreational and educative purposes as it prepares budding trappers for adulthood. The bushmeat captured in the vicinity of villages is generally consumed as snack food by children; it incidentally makes up a valuable part of their diet in its own right."

These technologies may help children solve child-sized problems (Bird & Bliege Bird, 2004): by transmitting subsistence techniques adjusted to their smaller size and lesser strength, children can more readily feed themselves and other children, and through such self-provisioning, maintain the autonomy of the peer group (see Lancy, 2024, pgs. 73-74 for extensive review). As we argue in section 6.4, such playful self-provisioning becomes an important source of nutrition during periods of food insecurity.

In non-industrialized settings, children also frequently manufacture their own toys (Lancy, 2016). In a recent survey, Lew-Levy et al. (2022) found that hunter-gatherer children manufactured many play objects such as dolls, games, or play shelters for themselves (see also Lancy, 2024). More than a third of the objects surveyed had no adult corollaries (e.g., figures, games). Riede and colleagues (2018, 2021) have also argued that children's object manufacturing may not only contribute to the innovation of novel objects in the present, but to children's future innovation capacities via affordance discovery. Supporting this point, among the Dogon, "the fabrication is an activity as important for the child as the very use of the toy; it takes him more time and provides him with a greater distraction by virtue of the fact that it often consists of a difficult technical exercise. It is thus that the toys having springs are much more delicate to cut out than they are to use; the manipulation of the knife, in a material as fragile as millet stalk, demands patience and know-how" (Griaule & Marcus, 1938, p. 31).

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5.4. Social norms & customs

Peer cultures contain unique social norms and customs not found in adult culture. In a series of observational studies, for example, Katriel studied the norms of northern Israeli peer groups, documenting the practice of *xibùdim* (Katriel, 1987). The name of this sharing practice itself reflects a child-marked, phonological deviation from the word *kibudìm*, referring to the adult practice of respect in public life. *Xibùdim* involves the sharing of 'bites' of snack foods between groups of children, which starts with the act of buying the treat, usually on the way to or from school. These sharing events occur only with peers, never adults. While such sharing may be opted into by younger children (5-7 years), it becomes ritualized among older children (8-11 years). Katriel ultimately argues that by forgoing self-interest, *xibùdim* reaffirms "the child's affiliation in a broader, loosely structured social network" (p. 317), and ultimately, regulates peer group relationships. Reflecting greater egalitarian values promoted in Israeli education, *xibùdim* nonetheless exhibits linguistic and normative innovations that do not appear in adult society.

Children's customs are not unique to Israeli society. Among Southern African Tsonga (Junod, 1927, p. 63):

> "Boys herding the goats have certain customs. When one of them emits a certain unseemly sound from the rectum, the others say to him: "Fakisa!" He must answer: "Cita munyakanya goben." (I have let out my wind by the rectum). This formula, which is Zulu, is secret. If he does not know it, they beat him and make him look after the goats till the end of the day. Should another boy reveal the answer to the uninitiated, they will punish him in the same way."

Among the Xavante of Brazil, food is always shared among all male adolescents, who live together in the bachelors' hut. Contrary to sharing practices among adults, food may also be kept for absent peers (Maybury-Lewis, 1967). Among the Manus, the peer group includes all children four to twelve and unmarried men (Mead, 1937, p. 222). In this group, children "compete in terms of their own capabilities and achievements; they do not invoke the wealth, position, or status of their parents."

5.5. Language

Children's linguistic repertoires are replete with unique forms generated by children themselves (Brown, 1973). Children regularly engage in lexical innovations—or neologisms—with intent, following the morphological rules of their language, and relying on their internal knowledge of words and their meanings (Becker, 1994; Brown, 1973; Clark, 2009; Motsiou, 2012; Shimron, 2003). In a longitudinal study of an American boy's speech from two to four years old,

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psychologist Judith Becker documented a "great variety of innovations" across a broad range of linguistic categories: agents, instruments, and contrastive compounds (1994), such as "building-crasher" to refer to an instrument that can knock buildings down, and "nose-beard" to refer to a mustache (p. 200).

Between 5 and 12 years of age, children begin to acquire their local vernacular (Labov, 1964). At this time, their speech tends to become more like that of their peers than that of their caregivers. For example, Kerswill (1996) shows that in Milton Keynes–an English town founded in the late 1960s–4-year-old's pronunciation of *ou* showed large variation, and was correlated with that of their caregivers. Children aged between 8 and 12 years, however, showed smaller variation in *ou* pronunciation, and that pronunciation was no longer correlated with that of their caregivers. Kerswill suggests that "the children are focusing on a norm that is different from that of adults [which] may constitute evidence for a new variety" (Kerswill & Williams, 2005, p. 192). In a study of Detroit's suburban teenagers, Eckert further showed that, while vowel qualities of younger children reflected their social class, for teenagers, vowel quality instead reflected their association with 'jock' or 'burnout' peer cultures (Eckert, 1988). Beyond pronunciation, lexical creativity is at the heart of adolescent slang, such as the 'shashification' of words (e.g., 'session' becomes 'sesh') (Fajardo, 2019).

Language activities are also central to adolescent peer group life. For example, 'The Dozens' is a form of ritualized verbal sparring once primarily widespread in African American adolescent boys' peer cultures, which usually involves escalating insults (including of the opponent's family) in front of a peer audience (Ayoub & Barnett, 1965; Lefever, 1981). Potentially sharing origin with similar verbal sparring games observed among Nigerian Igbo children and adolescents, this antecedent to rap helps build a sense of solidarity and establish social status within the peer group (Chimezie, 1976; Lefever, 1981; Wald, 2012). Gossip and storytelling also helps adolescents co-construct and transmit peer group gender and behavioral norms (Evaldsson, 2021).

Several studies suggest that innovative language use peaks in adolescence (Baxter & Croft, 2016; Tagliamonte, 2011). And, while there is debate regarding the language-change contributions of younger children, most agree that older children and adolescents (above the age of ten) are agents of language change (see Raviv et al., n.d. for review). For instance, Berbieri (2009) analyzed several corpora of spoken words to examine the distribution of the quotative 'be like' (as in, s/he said) in American English over time. 'Be like' was typical of adolescent speech between the late 1980s and 1990s, yet considered stigmatized and ungrammatical in a contemporaneous attitudinal survey (Blyth et al., 1990). The use of 'be like' has increased by "about 50% among men and 20% among women who were 16–26 in 1995/1996 to the corresponding age-band (the 27–40 year-old) in 2004/2005" (Barbieri, 2009, p. 86). This

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example illustrates that peer culture language is not necessarily abandoned as adolescents mature into adulthood, but rather can affect lasting language change.

5.6. Abandoned adult knowledge

Transecting the aforementioned domains, peer culture knowledge also seems to act as a repository, or incubator, for abandoned aspects of adult cultures. Medieval historian Philippe Ariès (1965) claimed that many of the play objects that children prefer are cultural technologies that adults no longer use. As Morin (2015) argues, however, children are not *just* preserving remnants of long-disappeared adult cultures. Instead, children incorporate abandoned adult cultural traits into their own activities, thus reinventing them. For example, Imamura (2016) observed a group of San boys aged 6- to 12-years participating in hunting pretense play in 2012. To create 'spears' for their 'hunt', the children cut branches and tipped them with bark to prevent injury during play. This technique is reminiscent of the traditional stick throwing games among adults, observed until the 1970s, during which young San men would throw sticks tipped with leather onto a sand mound. By the 1990s, Imamura observed this game among children only, arguing that "the old stick-throwing game played by older males persists in altered form as part of this children's game" (p. 183). The incorporation of spears is a further innovation. As San increasingly settled, their hunting activities also diminished. Thus, the use of the spear during pretense play, he argues, "may store and revive traditional San activities and memories" (p. 184).

The continual use of abandoned technologies in children's culture occurs with regularity across societies. Baka boys in Cameroon often play with traps, cultural technologies that adults have largely abandoned in favor of spears and smoke (Dounias, 2016; Gallois et al., 2017). Baka girls forage for wild plants and tubers in the surroundings of the village, a practice that is abandoned in favor of commercial forest products and agriculture in adulthood (Gallois et al., 2017). Among the Karajá, girls six to seven are adept at spinning thread using a spindle shape "preserved among the children, whereas it seems to have been lost to the adults" (Krause & Schütze, 1911, p. 243). Tylor (1871) also notes that while the friction fire drill had disappeared from use in Europe, at the time of his writing, boys in Switzerland still used it as a toy. Taken together, the literature suggests that children often reappropriate abandoned aspects of adult material and immaterial cultures, and reinterpret them to serve their own peer group needs. In doing so, this cultural knowledge is also preserved.

6. Peer culture & culture change

In the previous sections, we highlighted the largely autonomous nature of peer cultures, and the distinct knowledge they produce. We now address the question: Can peer cultures confer benefits to the community more broadly? Here, we argue that peer culture knowledge may be more

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broadly beneficial and adopted into adult cultures during rare but salient episodes of social and/or ecological change. Targeted research on this topic is currently limited. Nonetheless, illustrative case studies highlight plausible mechanisms through which peer cultures may have measurable fitness benefits. Specifically, we review instances in which children's peer interactions help communities orient themselves towards novel ecological and social conditions, contribute to community resilience, or lead to new cultural communities.

6.1. Matsés children's exploration

The Matsés are an Indigenous Amazonian population consisting of approximately 1,500 people living along the Javari River in Peru and Brazil (Fleck & Harder, 2000). Until the end of the 1960s, Peruvian Matsés lived in scattered mobile settlements in inland forests, and practiced hunting, fishing, horticulture, and the gathering of wild foods (Morelli, 2017). Historically, rivers—sites of (sometimes violent) encounters with outsiders—were dutifully avoided by adults and children alike (Fleck, 2003; Morelli, 2017). When Matsés still largely resided in the forest, much of children's activities involved emulating adult work, or assisting adults during subsistence activities. After contact with missionaries in the 1970s, Matsés began to settle in new patterns, residing in permanent villages along riverbanks (Fleck, 2003).

In her child-centered study of social change, anthropologist Camilla Morelli (2017) found that, as opposed to spending most of their time in the forest with adults, in these newer settlements, Matsés children as young as two years spent more of their time playing and exploring in or near the rivers with minimal supervision (Morelli, 2017). Through playful exploration, children became more closely acquainted with the rivers, learning to maneuver strong currents in small canoes and gaining experience in an ecology that was relatively less familiar to their parents. By middle childhood, children became not only proficient at fishing, but also shared their catch with others. In contrast, adult Matsés subsistence activities continued to be forest-oriented. While adults did collect some fish, this resource was not seen as 'proper' food: hunted meat continued to be preferred. In addition to building practical river-based skills, Matsés children developed affective relationships with the river through their exploratory peer play, leading to shifts in cultural markers of prestige (Morelli, 2017). While Matsés adults asked Morelli about her father's hunting skill, children instead inquired as to whether her father had a motor for his canoe.

While canoe-related technologies may have been acquired from non-Matsés, children's playful exploration helped them gain practical skills, ecological knowledge, and cultural orientations distinct from those of adults. As over-hunting in the surrounding villages depletes traditional forest resources (Morelli, 2017), child-produced fishing-related knowledge may become even more salient. This example highlights how children's peer group activities may help communities engage with, and gain command of, new ecologies.

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6.2. Mayan children's weaving

When cultural psychologist Patricia Greenfield and her colleagues started their work in the Chiapas region of Mexico, Zinacantec Mayan communities primarily practiced subsistence agriculture (Cancian, 1994). During this period, norms of dress were highly uniform, with one "true" (*bats'i*) design for each item of clothing with minimal inter-individual variation, and high conformity across generations (Greenfield, 2004). At this time, weaving knowledge was transmitted vertically and largely unidirectionally, from mothers and/or grandmothers to daughters, with structured scaffolding and error correction facilitated by highly proximal teaching (Childs & Greenfield, 1980). By the 1990s, however, community members increasingly participated in the cash economy, with girls and women involved in textile-related commerce, such as the embroidering of *servilletas* (napkins) which were used as placemats by tourists and other outsiders (Greenfield et al., 2000). Weavings thus represented an important source of income for the household. Mothers were also less available to support learning, as they were themselves engaged in market-related labor.

In longitudinal study, Greenfield and her colleagues observed the effects of these market-related changes in household labor on weaving practices. Notably, by the 1990s, girls were increasingly taught to weave by other children (sisters, cousins), rather than by their parents (Greenfield et al., 2000). The method of instruction also changed towards a more distal and learner-led approach, in which novices actively solicited help from their tutors. This more independent style of apprenticeship yielded more opportunities for creative experimentation in weaving design, leading to highly distinct and abstract textile patterns (Greenfield et al., 2000). These novel and more individualistic weaving patterns could then be sold on the regional textile market. In some cases, mothers and grandmothers even copied or were taught the creative designs of their daughters, resulting in reverse vertical transmission (Greenfield, 2004). By 2012, increased participation in formal education, greater market integration, and smaller family size had diminished the importance of weaving as a practice and art in Mayan households (Maynard et al., 2024). This example demonstrates how longitudinal research can capture children's contributions in salient but rare moments of culture change, and how child-to-child transmission can fuel creativity and innovation, which in turn can help communities better adapt to changing economic dynamics.

6.3. Nicaraguan Sign Language

In the 1980s, linguists Ann and Richard Senghas documented the emergence of a spontaneous language among deaf children (aged 10 years and under) who had come into sustained contact for the first time: Nicaraguan Sign Language (A. Senghas & Coppola, 2001; R. J. Senghas, 1995). Before the 1970s, deaf Nicaraguan children, primarily born to hearing parents, had little

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opportunity for instruction in sign language or interaction with other deaf children (R. J. Senghas, 1995). In these contexts, children often communicated at home via homesigns, which varied in form and complexity. With few primary schools for deaf children, peer contact was extremely limited (A. Senghas, 2003). In 1977, a school for the deaf was founded in Managua, which provided education for 25 elementary-aged children, expanding to 100 children by 1979. In 1980, a vocational school was also opened for adolescents, serving 400 deaf students by 1983. For the first time, many deaf children came together, with opportunities to assort socially as well. While instruction was in Spanish and focused on lip-reading, reading, and writing, outside the classroom children quickly systematized a simple language based on the combination of gestures and homesigns. Importantly, this first cohort had not been initiated into a pre-existing linguistic community (A. Senghas, 2003). Through "extensive horizontal contact, that is, interaction among peers of each age cohort" children created a new common language (A. Senghas, 2003, p. 514, but see Raviv et al., n.d. for critical review). Subsequent cohorts improved upon the structures generated by their predecessors by introducing their own innovations, such as spatial modulations, where signs produced in the same location are linked to a common referent (A. Senghas & Coppola, 2001). Such modulations were nearly absent in the first cohort, but were systematically evidence in later cohorts. Nicaraguan Sign Language, now formalized into a dictionary with a relatively large number of speakers and a vibrant Deaf community (A. Senghas, 2003), was invented and complexified by successive cohorts of children, interacting at unprecedented scales. Nicaraguan Sign Language is thus an example of how peer interaction can generate novel cultural forms, and even cultural communities themselves.

6.4. Children's foraging in diverse settings

Peer cultures, especially in non-industrialized settings, may play an important role in community food security. Specifically, Ethnoecologist Edmond Dounias (2021a) argues that children's peer cultures preserve knowledge of potentially edible resources which adults seldom target (Figure 3). Some of this knowledge is abandoned by adults: garden trapping among Cameroonian Baka children, for example, represents "a corpus of knowledge and know-how that adults no longer care about, and that still could ensure a reliable portion of meat procurement for domestic consumption" (Dounias, 2016, p. 10). Such knowledge may act as a safety net during periods of short- or long-term resource fluctuation, when food species normally targeted by adults are no longer available.

Examples highlighting the importance of peer cultures to children's foraging practices come from diverse societies. Among Massa and Mussey mixed-subsistence agriculturalists in the Logone region of Cameroon, children are the primary holders of wild food knowledge (e.g., toads, insects, fruit) (de Garine, 2005). While rich in vitamins and minerals, wild resources are not considered 'real food' by adults. Wild food knowledge is transmitted from child to child, with minimal intervention from adults (Dounias, 2014). In periods of food shortages, such as

when droughts and floods destroy plantations (de Garine, 1993), "food collected by children from the wild are eaten as snacks and may ensure up to 35% of [children's] daily food consumption" (Dounias, 2014, p. 3) Due to pressures including climate change and ethno-tourism, Hadza are increasingly reliant on market-based and agricultural resources for subsistence (Pollom et al., 2020). While fewer children participated in foraging in 2017 compared to 2005—when 95% of resources consumed by Hadza were non-domesticated—those who did forage in 2017 had a higher average caloric return rate than their predecessors (Pollom et al., 2020). Further, boys in 2017 hunted a larger breadth of animals than those in 2005. Importantly, these hunted species were small animals typical of child-specific foraging activities (Crittenden, 2016; Crittenden et al., 2013). These findings suggest that Hadza children are contributing to community food security by applying peer culture knowledge to increasing caloric returns and diet breadth during a vulnerable period of nutritional and ecological shifts. During the Pacific War and Allied Occupation (1941-1952), food shortages affected Japanese children, who were measurably shorter and lighter than their pre-war counterparts (Piel, 2012). To satiate their hunger, children foraged for nuts and fruits "alone, or with neighborhood children" (p. 407). Children also invented novel subsistence strategies: "When asked whether her parents taught her how to do this, Shingū said that she and the other village children came up with the idea together. They devised a novel way to fish for snails using a straw. Her mother boiled the snails for dinner" (p. 407). Overall, this evidence suggests that child-specific foraging knowledge, both transmitted and invented, buffers against diverse causes for food insecurity (Dounias, 2014; Pretelli et al., 2024).

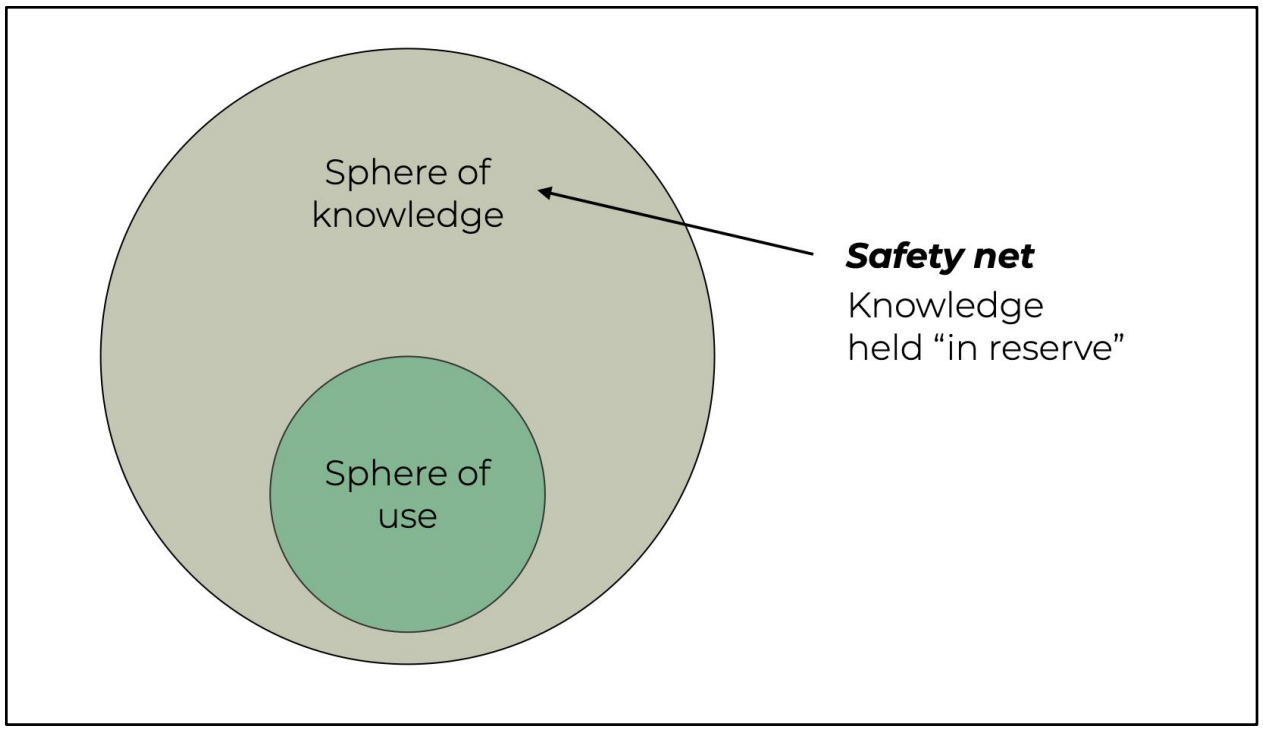

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Figure 3: Ethnoecologist Dounias (2021b) argues that when a community's 'sphere of use' and 'sphere of knowledge' completely overlap, knowledge is maximized, but there is little resilience to environmental crises. In contrast, when the 'sphere of knowledge' extends beyond the 'sphere of use', communities can be highly responsive to environmental change. Dounias argues that children's peer cultures hold in reserve seldom-used knowledge and know-how about potentially edible resources, thus representing a cultural safety net to resource fluctuation.

6.5. Summary of case studies

Overall, these case studies lend naturalistic support to the view that peer cultures can play an important role in community adaptability, especially in times of change. Several mechanisms unique to peer cultures are evident. Children's propensity to explore in new ecological and social settings can produce novel and up-to-date ecological knowledge, subsistence strategies, and linguistic communities. Learning from peers promotes creativity and discovery, leading to material culture innovations. Knowledge incubated within the peer group can act as a cultural safety net, called upon when adult knowledge is insufficient. And arguably, as a buffer against food insecurity, child-specific foraging knowledge is our most tangible evidence for the fitness benefits that peer cultures confer. It is important to note that we do not claim that peer cultures are the *only* mechanism by which communities adjust to change. Instead, in the case studies above, we highlight children's specific contributions, as these are overlooked in the current literature.

7. Towards an integrated study of peer cultures: New research avenues

Informed by related frameworks in cultural evolution and human life history theory, we have argued that long human childhoods may have evolved in part to support peer cultures, which in turn generate innovations that help communities adjust to social and ecological change. In this section, we now call upon researchers—with or without a specific interest in children—to consider the study of peer cultures in order to expand our understanding of cultural transmission, transformation, and diversity, and highlight a number of potentially fruitful avenues for future work.

7.1. What can peer culture reveal about cultural evolution?

Since its inception, cultural evolutionary theorists have been interested in understanding the mechanisms through which communities, particularly minorities, maintain distinct identities despite extensive contact (Boyd & Richerson, 1985). Research into this topic has advanced an understanding of in-group psychology (Over, 2018), ethnic markers (Mcelreath et al., 2003), and

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the function of social norms (Bunce, 2021). Studying peer cultures as a case of extreme intercultural contact can make similar inroads. Indeed, how often does one social group (children) maintain its culture despite overwhelmingly inhabiting spaces controlled by another social group (adults)–including *living in their home*?

In addition to living in an adult-dominated world, peer cultures experience additional threats to maintenance unobserved in adult cultures. Unlike adult cultures, for instance, peer cultures do not rely on formal institutions (e.g. schools, rites of passage) which facilitate highly efficient cultural transmission. In the absence of vertical and oblique transmission, peer cultures are transmitted through many horizontal or quasi-horizontal relays, risking copying error related stress. Peer group populations are rapidly replaced, meaning that traits must be spread quickly if they are to survive at all. By examining how peer cultures persist despite these compounding threats, modelers and fieldworkers alike can shed light on alternative mechanisms through which cultures can evolve. As of now, only Morin (2015) has proposed such a mechanism, *selection for proliferation*, by which peer culture traits themselves elicit frequent repetition, leading to their maintenance and spread. Whether such selection extends beyond children's folklore to traits such as material culture or ecological knowledge is currently not known. Structured observations are needed to elucidate how and from whom peer culture traits are invented and transmitted. Combined with observations, retrospective interviews with adults of different ages can help us understand why some traits persist for generations while others are almost immediately forgotten. Systematic quantitative surveys of existing peer culture traits are also needed to investigate how these differ in form and function from adult traits, and thus, how exactly children contribute to adaptive cultural variance (Fogarty & Kandler, 2020; Smaldino et al., 2024).

In this paper, we have focused on aspects of peer cultures that may benefit wider communities. However, we do not claim that all cultural traits produced within the peer group will be adaptive, nor that children are capable of producing all types of adaptive innovations. Indeed, many aspects of peer cultures are likely to evidence cultural evolutionary drift (Hahn & Bentley, 2003). Further, generating novel ecological knowledge may be useful when entering a novel ecological niche, but may provide no added benefit when entering a new social or economic niche. In this latter case, novel social norms (e.g., those associated with trade) may instead be more important. Based on the theoretical and empirical literature reviewed above, we posit that peer cultures are more likely to contribute innovations discovered via broad spatial (e.g., novel food patches) and social (e.g., communication norms) exploration. In contrast, we found little evidence for peer cultures producing complex technological innovations, potentially because learning to make and use complex technologies tends to occur in later adolescence and into early adulthood (Reyes-García et al., 2016). In turn, such experience may lay the groundwork for more goal-directed innovation for complex tasks (Mesoudi, 2021b). Overall then, future research is needed which

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helps elucidate causes for variation in peer culture traits, as well as the contexts in which these traits are adaptive and in which they are not.

7.2. Did peer culture contribute to the evolution of long human childhoods?

Researchers aiming to understand the evolution of long childhoods have increasingly incorporated horizontal learning into their models. Specifically, a multi-stage model whereby children gain basic competencies through practice with peers, after which they receive more specialized teaching from adults, has gained theoretical and empirical support (Gurven et al., 2020; Lehmann et al., 2013; Reyes-García et al., 2016). While important, these studies overwhelmingly focus on how peer learning contributes to *future* skill acquisition. Yet, recent work suggests that under conditions of uncertainty, organisms are unlikely to trade-off immediate rewards for delayed ones, even if the delayed reward has a much higher payoff (Villmoare et al., 2023). In other words, benefits of learning high-yield adult skills may be insufficient to justify developmental temporal discounting of long low-yield learning periods (Kramer, 2011). Accounting for the immediate products that peer learning confers—that is, peer cultures—can help resolve this contradiction. We have argued that peer cultures act as safety nets, incubators, and innovation generators. Bidirectional knowledge transfers between children and adults, more so than unidirectional transmission of stable culture from adults to children, can reduce the uncertainty of delayed rewards by ensuring that relevant knowledge is always up-to-date. This possibility is supported by research into collective adaptation, which suggests that *any* transient diversity, whereby a group maintains diverse solutions before converging on a common solution, "will improve the quality of the solution on which the group ultimately converges" (Smaldino et al., 2024, p. 454).

Connecting life history theory with collective adaptation to explain the evolution of long human childhoods compels two important areas of inquiry. First, experimental research is needed to assess whether 'immature' cognition may in fact partly reflect adaptations for peer cultures. We previously noted that children are unable to produce adult-like goal-directed innovation until 8 years (Rawlings, 2022). In contrast, children are better able to infer unlikely hypotheses than adults (Liquin & Gopnik, 2022), and can generate new knowledge through peer interaction (Damon, 1984). Such findings may reflect an age-graded division of cognitive labor (Wu et al., 2023), rather than cognitive immaturity on the part of children. Incorporating diverse forms of transmission–including horizontal and reverse vertical–into models aiming to understand the evolution of developmental plasticity (e.g. Frankenhuis & Walasek, 2020; Ratikainen & Kokko, 2019) can shed light on how age-graded divisions of cognitive labor help individuals adjust to varying environmental conditions.

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Second, our argument highlights a potentially important role for the 'reverse vertical' transmission of traits from peer to adult cultures. While this area of research has received significantly less attention than warranted, there are numerous examples of children transmitting knowledge to adults in other domains: children frequently teach their parents about new technology (e.g., digital media) and social norms (e.g., in immigration contexts)(Correa, 2016; White et al., 2011), reflecting the plausibility of this pathway. Further, the case studies reviewed in Section 6, as well as modeling research (e.g., Deffner & McElreath, 2022) suggest that learning from younger generations is most likely to occur during episodes of profound social, cultural, and ecological change. Longitudinal comparative ethnographic research tracking exogenous forces such as climate change and market integration, and endogenous forces such as changes in population structure can elucidate how and when adults may benefit from adopting peer culture traits from children.

7.3. How do peer cultures intersect with cognitive development?

Throughout the article, we described evidence for peer cultures at all stages of development: early childhood, middle childhood, and adolescence. In doing so, we demonstrated that peer cultures exist and are likely consequential at all ages. In what follows, we outline some predicted developmental shifts in the form and function of peer cultures through cognitive maturation.

Prior to the age of three, children are "simply not adapted for collaborating with peers, but only with adults" (Tomasello, 2024, p. 73). Reflecting improvements in joint attention (Tomasello, 2020) and self-regulation of executive thinking (Tomasello, 2024), three-year-olds begin to more successfully collaborate with same-aged peers (Brownell & Carriger, 1990). The emergence of sensitivity to intergroup relations and in-group status (Nesdale et al., 2003) also paves the way for new forms of social and cultural interactions with peers, and the development of a unique peer group identity (in-group) distinct from that of adults (out-group). Thus, equipped with these new cognitive representations and tools at around the age of three, children debut into the world of peer culture.

In early childhood, children utilize a variety of exploration techniques to learn the affordances of the physical and social world (e.g. Meder et al., 2021) This exploration can even result in gathering information that adults miss, due to flatter priors and openness to less conventional hypotheses (e.g. Liquin & Gopnik, 2022). In experimental contexts, children at this age are capable of engaging in the building blocks of cultural evolution, such as complex innovation and transmission (McGuigan et al., 2017). Thus, we believe early childhood is a critical period for forming underlying epistemic schemas for how the natural and social worlds work, in ways which can diverge from those of the adults in their community. More formal modeling and empirical work is needed to better understand how early divergence in epistemic schemas can lead to divergent downstream innovations.

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Children in middle childhood evidence sophisticated understandings of norms, morality, and their intersection with group identity (Amir et al., 2023; House et al., 2019; e.g. Karadağ & Soley, 2023; Schmidt & Tomasello, 2012). During this stage, children may develop their own norms and methods for maintaining those norms (e.g. Katriel, 1987), behaviors which may have lasting implications if these persist into adulthood (Reckin et al., 2020). In many subsistence societies, middle childhood is also marked by increased social responsibility, rule-governed and skill-oriented play, and (especially for boys) freedom of movement (Lancy & Grove, 2011). We suspect that the equal importance of work and play during middle childhood likely gives rise to novel technologies adjusted to children's size and strength, and the discovery of new foraging patches and associated ecological knowledge. Horizontal transmission also becomes more pronounced and sophisticated during this period (Strauss & Ziv, 2012), helping spread such peer-group inventions. We believe much more research is needed on peer-to-peer teaching and learning in this developmental stage, along with greater focus on how children create peer-specific technologies and norms.

In adolescence, peers become an increasingly dominant force for socialization. For example, in an experimental task, Italian and Singaporian adolescents were more likely to follow the sharing suggestions of peers than adults (Ruggeri et al., 2018). This life stage is also associated with increased cognitive flexibility, sensitivity to sociocultural influences, and risk-taking (Blakemore & Mills, 2014; Crone & Dahl, 2012b). Notably, risk-taking can enhance individual learning: in incentivized risk tasks, adolescents were more likely to take risks, and also to learn more in the task, "behavioral patterns [which] serve an adaptive function with respect to resource acquisition" (McCormick & Telzer, 2017, p. 417). Ethnographic research also suggests that adolescents are early adopters, rather than producers, of complex instrumental innovations (B. Hewlett, 2021b). Instead, their innovations likely occur in social domains, particularly in the realm of language. As noted in section 5.5, language is central to adolescent peer cultures, encompassing verbal sparring, story-telling, and gossip (Corsaro & Eder, 1990; Opie & Opie, 1959). It is not surprising, then, that adolescents are also considered key drivers of language change (Cheshire et al., 2008; Raviv et al., n.d.; Wiese, 2009). Future work should examine the unique role of peer cultures in the invention and incubation of new linguistic forms. Further, as they are biologically and culturally in closest proximity to adults, future studies should examine the role of adolescents in brokering between peer and adult cultures, and the contributions of such brokering to innovation through recombination.

7.4. How do peer cultures vary across contexts?

It is well recognized that developmental psychology suffers from a persistent sampling bias whereby children from the post-industrialized West are overrepresented, calling into question the generalizability of existing theory and findings to diverse cultural communities (Amir &

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McAuliffe, 2020; Nielsen et al., 2017). In response, cross-cultural research is becoming more widespread, with studies documenting important variation and similarities in social learning and innovation. However, we do not currently know the extent to which peer cultures also vary across diverse societies.

Many of the social and contextual factors that vary across societies can theoretically have downstream consequences for peer cultures. Some shared factors may lead to cultural convergence. For example, contamination games, such as cooties, appear spontaneously in many cultural contexts. Morin (2008) argues that contamination games which "best appealed to the universal mechanisms of social disgust were those which managed to be transmitted to the next generation of children," (p. 11, translated from French), explaining their similarities despite independent origins. Other factors are likely to drive variation. The demographic makeup of the population and the rates of child-child interaction seem particularly relevant. In societies where institutions lead to sharp age-based segregation (e.g., elementary, middle, and high schools), multiple age-specific peer cultures may arise independently. Further, rates of child caretaking can "affect the sex composition of the play group and the physical and social mobility and exploration possible for certain children; and, where caretaking is not limited to one's own siblings, it may shape contacts with children not in one's immediate family" (Weisner et al., 1977, p. 177). Population size also likely plays a role; while larger and more diverse peer groups may in theory produce more diverse cultural traits (Post et al., 2009), Lancy notes that multi-aged groups "had a ceiling effect on play complexity…Games all had to be simple enough to be played by toddlers" (Lancy, 1984, p. 231). Ecological context may also shape what games can be played: Griaule notes that Dogon children do not play ball games because these "simply cannot operate on cliffs, nor in the heavily wooded savannahs which are spread out at their feet" (Griaule & Marcus, 1938, p. 12). Cross-cultural studies cataloging how peer culture trait quantity and diversity co-vary with age segregation, task assignment, peer group size and composition, and ecology are needed to understand just how much peer cultures vary, and why.

For children living in post-industrial settings, access to physical spaces where children can assort independently from adults is waning. Instead, peer cultures are increasingly expressed online (Beavis, 2015; Tan, 2021): "Digital spaces are today's arcades and malls. They are the first place that young people go to feel connected... They are the sites that Gen Z uses to form a collective sense of generational culture" (Boffone, 2021, p. 21). In virtual reality spaces, for example, children evidenced age-graded peer cultures: young children focused on exploring the affordances of the virtual space, younger adolescents exchanged avatars, and older adolescents often clustered together to tell jokes and tease each other (Maloney et al., 2020). Children not only instruct each other on how to navigate virtual spaces, but also frequently help adults solve the technological problems they encounter (Maloney et al., 2020). Children can also affect significant change in the digital ecosystem. For example, adolescents in particular frequently

repurpose technology (e.g. apps) to meet their own needs, often in ways unintended by the developers (Boffone, 2021), which can lead to large-scale changes in the market and the functionality of new apps. Online spaces can also accelerate the speed of peer culture transmission. As an example, the spread of Sheng – a Kenyan Youth Language originating from Nairobi – to rural areas has been facilitated by online media such as Facebook and Instagram (Erastus et al., 2022). Overall then, and alongside waning physical spaces, children may use virtual spaces to enact, invent, and transmit peer cultures. As virtual worlds and social media are increasingly recognized as sites for cultural evolution (e.g. Acerbi, 2016; Carrignon et al., 2019; Vélez et al., 2024), we encourage researchers to attend to how children transform these spaces.

8. Conclusion

In this article, we have argued that children are independent producers and maintainers of autonomous cultures. Despite near-exclusive horizontal transmission, peer cultures are long-lasting and resilient. They may be an important source of community knowledge diversity, including both material and immaterial knowledge related to geography, ecology, subsistence, norms, and language. These diverse and distinct cultural repertoires may represent a source for new behaviors and technologies, and may keep others from disappearing. Cultural traits maintained within the peer culture reservoir may then be 'reactivated' to help communities adapt to rare but salient social and ecological change. Case studies from anthropology, psychology, linguistics, and ethnoecology suggest that peer group activities, including exploration, peer learning, and the propensity to maintain abandoned adult cultural traits, may contribute to community adaptation, resilience, and in some cases (e.g., Nicaraguan Sign Language) may even produce new cultural communities.

Critically, our perspective has implications for theories about the evolution of long human childhoods: rather than just more time for learning adult skills, long childhoods also allow for the generation and maintenance of peer cultural products. The ubiquity and regularity of peer cultures across societies further bolsters this point, suggesting there may have been active selection pressure for the social and cognitive features that support peer cultures. Children's strong tendencies to explore, in addition to their natural abilities as peer teachers, may also have evolved not just to facilitate learning *adult culture from adults*, but also for creating *peer culture with peers*.

We do not claim that peer cultures are the only mechanism by which communities adjust to change. Nor do we claim that we have presented irrefutable evidence for these processes. Instead, we hope to stimulate new theoretical and empirical work which aims to fully understand the prevalence, variation in, and impact of peer cultures on cultural evolutionary processes. If our hypotheses are supported, such research can uncover new mechanisms by which cultures can

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evolve. If they are not, such research can still shed new light on a cross-culturally robust yet understudied social phenomenon central to children's development. We thus hope that this paper serves to validate this area of inquiry, and galvanize other researchers to more seriously consider children's role as active agents in cultural adaptation.

https://doi.org/10.1017/S0140525X24001377 Published online by Cambridge University Press

Acknowledgements: Thank you first and foremost to the BaYaka, Bandongo, Hadza, and Shuar children and families who inspired these ideas. Thanks to Ilaria Pretelli, Edmond Dounias, Marco Smolla, Felix Riede, Alyssa Crittenden, Lee Gettler, Luke Glowacki, Zachary Garfield, Sarah Pope-Caldwell, Bruce Rawlings, Keren MacLennan, Patricia Greenfield, Michael Tomasello, and members of the Durham cultural evolution research center for sanity checks throughout the writing process. Thanks to Julia Bainbridge for reviewing examples from the Human Relations Area Files. Thanks to David Lancy, Rob Boyd, April Nowell, Limor Raviv, Damian Blasi, and Vera Kempe for extensive feedback on the manuscript, which helped strengthen our argument. Thanks to Domink Deffner and four anonymous reviewers for their feedback.

Competing Interests: None.

Funding Support: This research received no specific grant from any funding agency, commercial or not-for-profit sectors

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