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Irrelevant-action imitation is short-term and contextual: Evidence from two under-studied populations

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Abstract

Across the lifespan and across populations, humans 'overimitate' causally unnecessary behaviors. Such *irrelevant-action imitation* facilitates faithful cultural transmission, but its immediate benefits to the imitator are controversial. Over short time scales, irrelevant-action imitation may bootstrap artifact exploration or interpersonal affiliation, and over longer time scales it may facilitate acquisition of either causal models or social conventions. To investigate these putative functions, we recruited community samples from two under-studied populations: Yasawa, Fiji, and Huatasani, Peru. We use a two-action puzzle box: first after a video demonstration, and again one month later. Treating age as a continuous variable, we reveal divergent developmental trajectories across sites. Yasawans (44 adults, M = 39.9 years, 23 women; 42 children, M = 9.8 years, 26 girls) resemble documented patterns, with irrelevant-action imitation increasing across childhood and plateauing in adulthood. In contrast, Huatasaneños (48 adults, M = 37.6 years, 33 women; 47 children, M = 9.3 years, 13 girls) evince a parabolic trajectory: adults at the site show the lowest irrelevant-action imitation of any demographic set in our sample. In addition, all age sets in both populations reduce their irrelevant actions at Time 2, but do not reduce their relevant-action imitation or goal attainment. Taken together, and considering the local cultural contexts, our results suggest that irrelevant-action imitation serves a short-term function and is sensitive to the social context of the demonstration.

KEYWORDS

culture and development, overimitation, social learning

1 | INTRODUCTION

Humans are born, grow up, live, and die in diverse environments – from the tropics to the arctic desert. Humans achieve this adaptability using derived capacities for flexible behavior, including both social learning (Boyd, Richerson, & Henrich, 2011; Whiten & Erdal, 2012) and problem solving (Pinker, 2010).

Human social learning itself is flexible and sensitive to context and content (Henrich & McElreath, 2003; Hoehl et al., 2019). In experimental studies, children imitate in ways that are statistically sound across multiple demonstrations and demonstrators (Buchsbaum, Gopnik, Griffiths, & Shafto, 2011; Evans, Laland, Carpenter, & Kendal, 2017). Children also adjust the fidelity of their imitation depending on demonstrator intention (Gardiner, 2014; Gergely, Bekkering, & Király, 2002), task difficulty (Flynn, Turner, & Giraldeau, 2016), material costs (Keupp, Bancken, Schillmöller, Rakoczy, & Behne, 2016), as well as combinations of social, causal, and other contextual factors (Burdett, McGuigan, Harrison, & Whiten, 2018; Clay, Over, & Tennie, 2018). Studies that allow for initial independent exploration, followed by a demonstration and a test phase, show that children also use hybrid strategies of blending independent and social learning (Wood, Kendal, & Flynn, 2013a),

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or of initial copying followed by later editing of their own actions (Chudek, Baron, & Birch, 2016; Whiten, McGuigan, Marshall-Pescini, & Hopper, 2009).

These results mirror ethnographic observations: humans copy others, but also edit and innovate on what they have previously learned. Quantitative ethnographic studies provide evidence that outside the laboratory, learners combine what they learn from multiple sources and edit that content selectively. This has been documented, for example, in honey-gathering by Jenu Kuruba people in India (Demps, Zorondo-Rodríguez, García, & Reyes-Garcia, 2012), across multiple domains among Yasawan villagers in Fiji (Kline, Boyd, & Henrich, 2013), and for food taboos in a Republic of Congo society (Aunger, 2000). This seems to be adaptive, in that it takes advantage of the low-risk nature of social learning but still allows individuals to improve on others' knowledge based on their own experience.

One type of human imitation has defied simple functional explanation: copying causally irrelevant actions (Nielsen, Mushin, Tomaselli, & Whiten, 2014a; Whiten et al., 2016), or what Lyons, Young, and Keil (2007) termed 'overimitation' (we will use the more neutral phrase *irrelevant-action imitation*, but see Hoehl et al., 2019 for defense of the term 'overimitation'). Irrelevant-action imitation appears to be a derived social learning capacity in humans, in that it is not shown by chimpanzees (Horner & Whiten, 2005), bonobos (Clay & Tennie, 2017), or orangutans (Nielsen & Susianto, 2010). Irrelevant-action imitation is evident in all human populations where it has been investigated (Hoehl et al., 2019), including a variety of populations from North America and Western Europe (see Over & Carpenter, 2012a; Whiten et al., 2016), and single studies among Kalahari Bushmen (Nielsen & Tomaselli, 2010), Western Aboriginal children in Australia (Nielsen, Mushin, et al., 2014a), the Aka and Ngandu of the Congo basin (Berl & Hewlett, 2015), and preschool children in Japan (Taniguchi & Sanefuji, 2017). Irrelevant-action imitation appears robust in many experimental designs that aim to motivate selective copying (e.g., Chudek et al., 2016; Keupp, Behne, & Rakoczy, 2013; Lyons et al., 2007; for review see Over & Carpenter, 2012a), and occurs even when participants are unaware they are part of a study (Whiten et al., 2016). Strikingly, irrelevant-action imitation tends to increase in fidelity across development, reaching levels of 'super-copying' among adults (McGuigan, Makinson, & Whiten, 2011). Nonetheless, there is increasing evidence that the fidelity of irrelevant-action imitation is moderated by participant social motives (for review see Hoehl et al., 2019).

Most researchers view irrelevant-action imitation as an important psychological capacity that supports uniquely human culture. Specifically, researchers have proposed two classes of functions for irrelevant-action imitation. The first is *instrumental*, to facilitate learning about technologies or practices that are ineffective if not carefully executed (Lyons et al., 2007; McGuigan et al., 2011; Whiten et al., 2016). According to the instrumental accounts, cumulative cultural processes have produced tools and practices that are causally effective but difficult to understand. As a result, it is in an individuals' interest to faithfully copy others to avoid missing steps that are important but opaque (Dean, Kendal, Schapiro, Thierry, & Laland, 2012). Indeed, faithful imitation can be stronger for causally opaque actions (Burdett et al., 2018; Gardiner, 2014; McGuigan, Whiten, Flynn, & Horner, 2007).

Research Highlights

- Artificial fruit task conducted in two under-studied populations (Yasawa, Fiji, and Huatasani, Peru) provides the first cross-cultural, cross-sectional, and longitudinal data on irrelevant-action imitation (IAI).
- Finds a novel developmental trajectory in Huatasani of less faithful IAI among adults compared to children.
- IAI decreases at a one-month follow-up for all demographic sets of participants, while rates of relevant-action imitation and goal attainment remain high.
- Patterns suggest IAI serves a short-term function and that motivations for IAI are shaped by social context.

The second class of functions proposed for irrelevant-action imitation is *social*, to signal affiliative intentions or shared social norms (McElreath, Boyd, & Richerson, 2003; Over & Carpenter, 2012a; Watson-Jones, Legare, Whitehouse, & Clegg, 2014; Watson-Jones, Whitehouse, & Legare, 2016). According to social accounts, human societies are based in part on conventions and norms along which individuals must coordinate interactions. In this context, acting like others promotes affiliation by signaling one's value as an interaction or relationship partner. For example, similarity through faithful imitation could signal an actor's knowledge of norms and a willingness to conform (Kenward, 2012; Kenward, Karlsson, & Persson, 2010), their predictability (Bernieri & Rosenthal, 1991; Hove & Risen, 2009; Manson, Bryant, Gervais, & Kline, 2013), or their ability to coordinate with others (Sebanz, Knoblich, & Prinz, 2005). Low-cost, high-fidelity imitation is not a commitment to cooperate, but it may demonstrate the capacities and motives necessary for successful coordination. This account can explain why, for example, children imitate more faithfully when ostracized (Over & Carpenter, 2012a; Watson-Jones et al., 2014, 2016). It also accords with evidence that American children copy more faithfully after playing a mimicry game (Yu & Kushnir, 2014), and copy more faithfully when a demonstration is framed as conventional rather than instrumental (Clegg & Legare, 2016; Legare, Wen, Herrmann, & Whitehouse, 2015).

Both instrumental and social accounts of irrelevant-action imitation allow for distinct time scales over which the behavior may function. *Instrumental* irrelevant-action imitation may facilitate short-term object exploration (Wood, Kendal, & Flynn, 2013b), or it may directly stimulate long-term encoding of how something works (Lyons et al., 2007). *Social* irrelevant-action imitation may facilitate short-term affiliation within an interaction (Over & Carpenter, 2012b; Vivanti, Hocking, Fanning, & Dissanayake, 2017), or it may stimulate long-term encoding of shared social conventions (Clegg & Legare, 2016; Watson-Jones et al., 2016). As others have argued (e.g., Chudek et al., 2016; Hoehl et al., 2019), these different

functions, at different timescales, are not mutually exclusive, but may be functional subtypes or context-specific instantiations of irrelevant-action imitation.

1.1 | Present study

Most existing research investigates irrelevant-action imitation on a short time scale, with demonstration and testing phases in a single experimental session (though see Simpson & Riggs, 2011). Such designs cannot disentangle short-term behavior from long-term learning, and may overestimate the role of irrelevant-action imitation in cultural evolution. This study therefore aims to assess the durability of imitated irrelevant actions over time, using both cross-sectional and longitudinal data from participants in two populations. Specifically, we extend a classic artificial-fruit study (see Horner & Whiten, 2005 and McGuigan et al., 2011) among two under-studied populations: a rural Indigenous Yasawan community in Fiji, and a rural altiplano community in Peru. We collect cross-sectional data across all ages and use model fitting techniques to infer development changes. To assess the durability of different kinds of imitation over time, we collect longitudinal data from a subset of participants, allowing them to interact with the puzzle box a second time, around a month after their first demonstration and use. Our hypotheses are guided by the assumption that the form of irrelevant action imitation – including its robustness within individuals over time and across culturally distinct populations – should follow the specific functions for which it evolved.

1.2 | Hypotheses

We aim to test several hypotheses. First (Hypothesis 1), given existing results across populations (see Hoehl et al., 2019), the presence and developmental trajectory of irrelevant-action imitation should replicate in two new cultural contexts. We did not make strong predictions about variation in imitation across the two sites in this study, because Yasawa and Huatasani share similar social learning contexts: children are involved in adult activities in everyday life, adults expect children to learn largely by observation with minimal interference, and schooling is focused on rote memorization of textbook content in a colonial language. On the other hand, there are enough differences in the two contexts' specific histories and technological tool kits that we could also envision different patterns of imitation. We describe some relevant similarities and differences between Yasawa and Huatasani below, and we bring these to bear on our results in the Discussion. In our analyses, we statistically evaluate the effects on IAI of features of the samples that were difficult to control, including latency of participation from the start of the study, and the gender of participants.

Second (Hypothesis 2), our community samples capture wide individual-level variation in education, including among adults. This allows us to evaluate the proposal that experience with formal education drives irrelevant-action imitation (see Berl & Hewlett, 2015) by separating out the effect of age from schooling. Population variation in formal schooling is often cited as a reason to study social learning phenomena in non-Western contexts, on the assumption that formal schooling not only teaches what to learn, but also *how* to learn (see e.g., Berl & Hewlett, 2015; Nielsen, Mushin, et al., 2014a). For example, there is evidence that pedagogical instruction can limit independent exploration in an experimental task (Bonawitz et al., 2011). However, previous studies assume that group-level mean differences in education are causal of differences in imitation patterns. Such comparisons often involve comparing Western versus non-Western populations that differ in access to schooling, but also in a myriad of other ways that could confound the results (Kline, Shamsudheen, & Broesch, 2018). In our study, years of education is a quasi-continuous variable within two populations, affording a cleaner test of the hypothesis. If individual-level years of education predicts irrelevant-action imitation at Time 1 in both populations, this would support the idea that formal education increases individuals' propensity for high-fidelity imitation.

Third (Hypothesis 3), we manipulate the social demands of the experimental context to assess the norm acquisition function of irrelevant-action imitation. In a between-subjects framing manipulation, participants hear either a neutral or a permissive script. The permissive script (described below) makes clear that there are different ways to open the box, and participants are not expected to copy the precise method demonstrated in the video. If irrelevant-action imitation serves the function of acquiring local conventions that are sustained by normative sanctions (e.g., Keupp et al., 2013; Watson-Jones et al., 2014), then there should be lower levels of irrelevant-action imitation in the permissive script condition.

Fourth (Hypothesis 4), we use longitudinal data to assess whether irrelevant-action imitation is durable over subsequent encounters with an object, in comparison to imitation of other demonstrated actions (i.e., relevant actions and goal attainment). If participants continue to perform irrelevant actions at Time 2, this is consistent with a long-term encoding function of irrelevant-action imitation, be it encoding a causal mechanism or a convention. If irrelevant actions are selectively dropped at Time 2, this suggests a short-term function, whether instrumental exploration or social affiliation.

2 | METHODS

2.1 | Choice of study populations

The lack of global sampling is a pervasive problem in psychological research (Henrich, Heine, & Norenzayan, 2010) including developmental psychology (Nielsen, Haun, Kartner, & Legare, 2017). We chose our study sites for comparison primarily because the researchers have expertise and long-term fieldwork experience in these regions (Moya in Huatasani, Peru; Kline and Gervais in Yasawa, Fiji) and because work at these sites will improve the global coverage of sampled populations with particular features relevant to the development of social learning. In comparison to a typical Western sample, these populations have more kin-based social organization, mixed-age socialization among children, and learning of practical

skills outside the classroom (see also Berl & Hewlett, 2015; Clegg & Legare, 2016; Nielsen & Tomaselli, 2010; Nielsen, Tomaselli, Mushin, & Whiten, 2014b; Shneidman, Gweon, Schulz, & Woodward, 2016).

These sites also provide a valuable comparison beyond the standard of studying one 'Western' and one 'non-Western' population, wherein market integration and formal education are often assumed to be the root of any between-population differences. Both sites are in developing nations with histories of colonization and both have similar systems of formal education that focus on rote memorization. This makes it unlikely that any variation across sites is due to a general effect of Westernization. Instead, we make sense of our findings using more theoretically and ethnographically meaningful explanations, including community cohesiveness and attitudes toward outsiders. The latter is influenced heavily by the divergent colonial histories at each site, and is relevant to this study because 'white' outsiders, including the coauthors, are often referred to by the same ethnic group terms used to refer to the colonizing population. Since we did not predict differences based on this a priori, we discuss this as a possible explanation only in the Discussion section. Most of the world's current cultural variation exists outside of industrial and post-industrial settings (see Henrich et al., 2010), so such site-based comparisons more efficiently leverage cross-cultural variation for theoretical purposes than do studies that compare 'the West versus the rest' (Kline et al., 2018).

2.1.1 | Yasawa, Fiji

Kline and Gervais collected data in two villages on Yasawa Island, in the northwest region of the Fiji Islands. Each village is made up of 100–200 Indigenous Fijians. Social life is organized by a hierarchy of patri-clans with a hereditary chief. Even for children, life is shaped by a network of kinship relations and obligations, and by local Christian churches (Methodist and Assembly of God). Villagers engage primarily in a horticulture–fishing subsistence economy with a strongly gendered division of labor, though many have worked in the tourist industry on occasion. There are no permanent local markets, broadcast television, or public utilities in these villages. Radios are common and cell phones have become increasingly prevalent (though unreliable) since 2010. The British made Fiji an official colony in 1874, until Fijian independence in 1970. As a result, Fiji still has a British-style formal school system. Most adults in the study population have completed primary school, while some have secondary or tertiary schooling (obtained off Yasawa island). As elsewhere in Fiji, parents in these villages often regard schooling as a means for gaining future employment through fluency in English, rather than as a goal that is valuable in itself or in the context of village life (Brison, 2003; Veramu, 1986).

2.1.2 | Huatasani, Peru

Moya collected data in the rural town of Huatasani, Puno, in the Southern Peruvian Altiplano. Its approximately 2,000 residents engage in mixed economic strategies that include agro-pastoralism, commerce, and labor migration to nearby mines. Kinship ties are important for cooperation in ritual and subsistence activities, and shape children's social learning opportunities early on. Market integration, phone access, and exposure to urban Peruvian and Latin American TV media is widespread and increasing. For example, a local cell phone tower was built 3 years before this research was conducted, before which there was only one public phone in town. The Peruvian government provides much infrastructure, including public primary schools, a high school, and a health clinic in town. School attendance is mandatory, and all instruction is carried out in Spanish, despite Quechua or Aymara being the more common home languages. The teacher–pupil relationship is relatively hierarchical, a relatively rigid national curriculum is followed in schools, and pedagogical techniques emphasize memorization and repetition. Outside of the schools, unstructured peer socialization in mixed-age groups is much more common at this site than in more industrialized, urban societies (Moya, Boyd, & Henrich, 2015).

2.2 | Participants

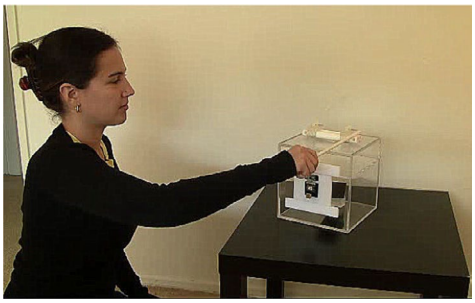
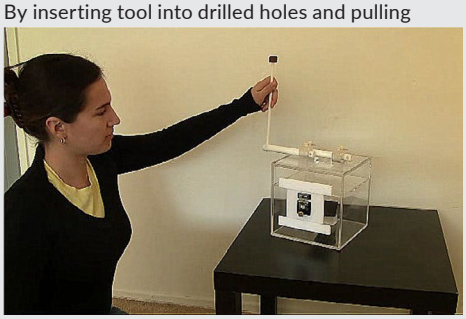
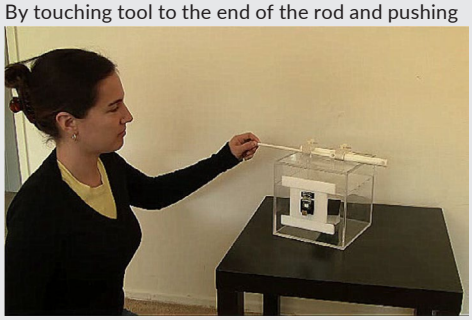
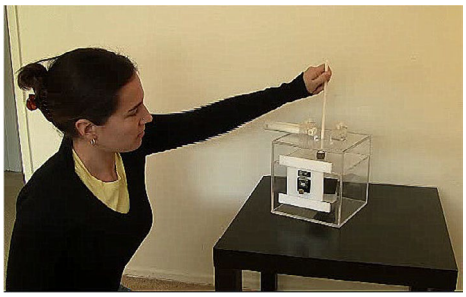
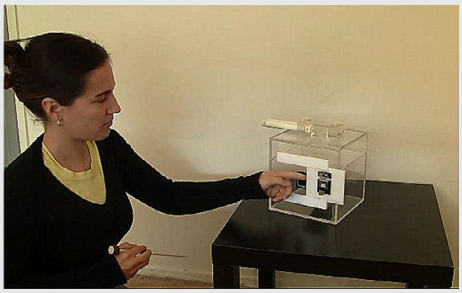
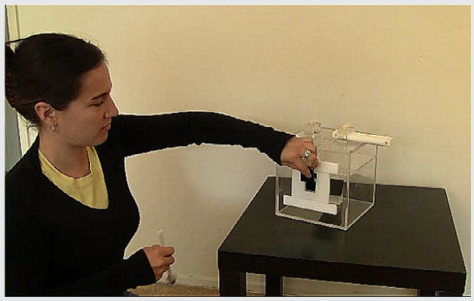
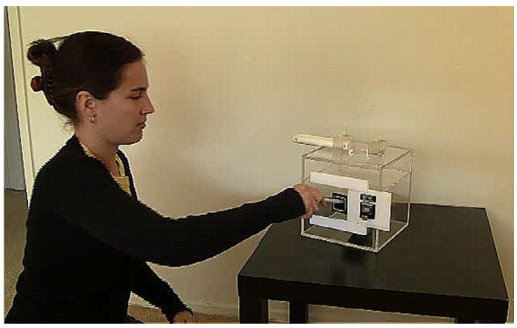
Researchers enrolled participants at both sites for two waves of data collection. For the first wave, henceforth Time 1, the Yasawan sample (n = 86) included 44 adults (18yo+; M = 39.9 years, Range = 18–71 years; 23 women) and 42 children (M = 9.8 years, Range = 5–13, 26 girls). The Huatasaneño sample (n = 95) included 48 adults (M = 37.6 years, Range = 20–70 years, 33 women) and 47 children (M = 9.3 years, Range = 4–15 years, 13 girls). At both sites, we recruited adults based on convenience sampling for similar numbers of male and female participants. In Yasawa, we recruited children at one village school, and ran the study in a teacher's home on school grounds. In Huatasani, children were recruited in the community. All participants in Huatasani participated in a centrally located private room that we rented. In both cases we gained parental consent and child assent. Only one person was excluded from the study, due to a video recording error.

For the second wave, henceforth Time 2, we recruited participants from among the Time 1 participants, about one month after their participation in Time 1. At Time 2, the Yasawan sample included 25 adults (M = 41.9 years, Range = 18–71, 13 women) and 32 children (M = 9.7, Range = 5–13, 19 girls); the Huatasani sample included 22 adults (M = 41.6, Range = 21–67, 17 women) and 14 children (M = 8.4 years, Range = 5–14, 3 girls).

2.3 | Stimuli

We used a puzzle box with a two-action sequence, as in Horner and Whiten (2005) and McGuigan et al. (2007) (see Table 1). The transparent box has a single hole in the top, blocked by two rods that can be pulled or pushed to either side. Moving the rods leads to a false ceiling and no reward. The box also has a side entry, blocked by a door that can be slid to either side or lifted. The door accesses an opaque tube inside the box, which contains the reward. We also included a Velcro tool that could be used to extract the reward from inside the tube.

TABLE 1 Description of the two video versions used in the experiment, with still images taken from the demonstration videos

Action	Video version 1	Video version 2
Taps outside of box	Taps outside of the box with tool, three times 	
Removes rods	By inserting tool into drilled holes and pulling 	By touching tool to the end of the rod and pushing 
Taps false ceiling	With tool, three times 	
Opens side entrance	Slides door using hand 	Lifts door using hand 
Inserts tool	Extracts reward pouch, and obtains reward from the pouch 	

At Time 1, all participants watched a video recording of a white North American woman silently obtaining candy from the box. This demonstrator did not look at the camera, speak, or provide any ostensive cues. Participants saw one of two versions of the video, each with the same number of irrelevant and relevant actions (Table 1). The videos differed only in the manner of rod removal (irrelevant to obtaining the reward) and door opening (relevant to obtaining the reward). Half of participants saw Video 1; which video was shown was randomly selected. At Time 2, participants did not watch any video, but instead were asked to open the box again, with no additional demonstration. We used two versions of the video, rather than a control condition, to rule out the possibility that any relevant imitation we found was due to an affordance of the stimuli. This was necessary because we included a script manipulation; the unpredictability of fieldwork, the small size of the Yasawan population, and the time-intensiveness of recruiting from the Huatasaneño population made it uncertain whether we could recruit enough participants to include a separate control condition as well. We found that participants did match the relevant actions in the version of the video they saw (see Data S1), suggesting that imitation effects are not due simply to the affordances of the stimuli.

We opted to use a video demonstration for several reasons. First, this ensured that the demonstration was identical across sites. Each study was conducted by a separate field team, and the teams were unable to contact one another during the study period due to the unavailability of phone or internet access. Second, the demonstrator in the video was equally unknown to participants at both sites, which avoided copying biases based on the demonstrator's social relationships with locals. This is a concern especially in Yasawan communities, wherein visitors cannot be present in villages without formal welcoming ceremonies. Any Indigenous Fijian visitor (including our research assistants) must immediately identify their kinship relationship to the village and to individual families, and this structures all social interactions that follow the first meeting. We used a white North American demonstrator so that the demonstrator would be perceived as an outsider at both sites, in order to minimize the possibility of different model-based biases across the two sites (Laland, 2004; Wood et al., 2013b). We did not anticipate that outsiders would be viewed differently prior to the study, but see the Discussion for how this may have affected our results. Finally, to rule out the explanation that irrelevant action copying is due to ostensive cues triggering a pedagogical context, we used video to exclude any ostensive cues by the demonstrator. At both study sites, a lack of these cues (eye contact, use of name, interaction) from a live demonstrator would communicate hostility, which would interfere with participants' willingness to learn socially.

2.4 | Procedure

At each field site, we first obtained broad consent from the community for our presence in the local area, before seeking consent from school officials, families, and finally from individual adults and children who were invited to participate. All study procedures, including consent, were approved by the (University Anonymized) Institutional Review Board for ethical conduct.

2.4.1 | Time 1

A university-affiliated researcher (Gervais in Yasawa, Moya in Huatasani) administered the study, with a research assistant, and in a local language (Spanish in Huatasani; Standard Fijian in Yasawa with adults and a Yasawan dialect with children). We video-recorded all trials, and a coder blind to both the conditions and hypotheses coded participants' behavior from video. After introducing the task, we prompted participants: 'Thank you. Please sit right here and watch the video, then you can try it'. An alternative script used more permissive language: 'There are many ways that the box can be opened; one of the many ways is followed by the girl in the video. You are free to choose whichever way you like to follow'. (For the full scripts and participant assignment to script, see Data S1). The experimenter then played the video. In Yasawa, the experimenter played the video twice for all participants, because the initial participants in Yasawa requested to watch the video a second time. Because the researchers ran the study simultaneously at each site, and cell phone access was minimal to none, we were not able to adjust the procedure at the Huatasani site to play the video a second time. See the Discussion section for an explanation of why this cannot account for our results. At the end of the video, participants were told they could 'go ahead and try it'. After the participant successfully opened the box or after 5 min had elapsed, we asked debriefing questions (see Data S1), thanked participants for their help, and gave them an additional candy.

2.4.2 | Time 2

The second phase of the study tests the durability of irrelevant-action imitation. We ran the Time 2 follow-up about one month (M = 31.4 days, Range = 3–42) after Time 1, with all available Time 1 participants. At Time 2, we did not show participants a video. Instead, we invited them to participate in a follow-up, saying: 'I would again like you to open that box, but this time you will not watch a video. Once again, if you open the box, you can keep the candy inside'. Those who consented to participate again were told, 'This is the same box you opened last time. Go ahead and try it again'. After the participant successfully opened the box, or after 5 min had elapsed, participants were asked a few debriefing questions (see Data S1). After the debriefing questions, we thanked participants and gave them an additional candy for their participation.

2.5 | Video coding

We video-recorded all trials. One trial from Peru was dropped from the study due to a recording error. An undergraduate research assistant who was blind to the hypotheses and the conditions coded all videos. The coder recorded only a set of behaviors as defined in a coding scheme, and we aggregated the coded behaviors into three

dependent variables scores: irrelevant-action imitation, relevant-action imitation, and goal achievement (Table 2). We scaled the scores to facilitate ease of interpretation in direct comparisons, using the 'scale' function in R (R Core Team, 2013), without centering. This allows us to compare the relative performance of participants on each scale (irrelevant, relevant, and goal achievement) while holding constant the number of points available for each scale (McElreath, 2018).

2.6 | Demographic data

To supplement the experimental data, we draw on demographic data to investigate the effects of gender and years of education on the behavioral outcomes. For missing education data (Yasawa: children = 4, adults = 3; Huatasani: children = 5, adults = 23), we imputed education data based on site, age set (adult or child), age in years, and gender, using the R package 'mice' (Stef van Buuren, 2011).

3 | RESULTS

Hypothesis 1 Both populations display irrelevant-action imitation at Time 1, but developmental trajectories vary between the sites.

We found that participants at both sites displayed irrelevant-action imitation at Time 1. For means and standard deviations of irrelevant-action imitation scores by age group and site, see Table 3. For analyses that are equivalent to those in previously published studies of overimitation, we include means comparison tests in the Data S1.

3.1 | Site and age affect imitation and goal achievement

To study the developmental trajectory of changes in irrelevant-action imitation in our sites, we use model selection tools to compare several regression models reflecting different ways that age can map onto social and cognitive development. Each of these models predicts a given imitation or goal achievement score from an age parameter using Time 1 data.

To select the best-fitting measure for age, we compared models with age in years (Age_{yrs}), as well as with age in years with all adult ages capped at 18 years old (Age_{cap}). Age 18 is an arbitrary cut-off.

TABLE 3 Shows the means with standard deviations in parentheses, for irrelevant-action imitation at Time 1 by Site and by age group

	Adult	Child	All
Fiji	8.5 (2.0)	7.2 (2.5)	7.9 (2.3)
Peru	5.3 (2.1)	6.8 (3.1)	6.1 (2.8)
All	6.9 (2.6)	7.0 (2.8)	7.0 (2.7)

Note: The irrelevant-action imitation scale has a maximum score of 13 and a minimum of 0.

TABLE 2 Shows the key for scoring coded raw behaviors (e.g., number of taps, door opening technique) as coded by a research assistant, into goal achievement, relevant-action, and irrelevant-action imitation scores

Score	Points
Relevant-action imitation (0–3)	+1 if the participant opened the door at all +1 if the participant opened the door in the way demonstrated in their video (either slide or lift) +1 if the participant opened the door **only** in the way demonstrated in the video
Goal achievement (0–2)	+1 if the participant breached the entryway (with hand or tool) +1 if the participant obtained the candy reward
Irrelevant-action imitation (0–13)	*Actions on outside of box (max of 4)* +1 tapping the outside of the box at all +1 tapping the rods on top of the box +1 using the tool for tapping +1 tapping exactly 3 times *Actions on rods (max of 6)* +1 for each rod moved (max of 2) +1 if the participant moved the rod(s) in the way demonstrated in their video (either push or pull) +1 if the participant moved the rod(s) **only** in the way demonstrated in their video +1 if the participant used the tool in the same way as demonstrated in their video (either push or pull) +1 if the participant used the tool **only** in the way demonstrated in their video *Actions on false ceiling (max of 3)* +1 tapping on the false ceiling inside the box +1 using the tool to tap on the false ceiling +1 tapping exactly 3 times

We chose this age because it is feasible that cognitive developmental change relevant to this task asymptotes by 18 years old, and because it is consistent with IRB standards for 'adults' for the purposes of consent procedures. In Yasawa, no participants between the ages of 13–18 were recruited because all children were recruited at village primary schools where enrollment ends at age 14, and there are no secondary schools on the island. In Huatasani, children were recruited in the community to match the age range available in the Fijian sample, such that no participants between the ages of 15–18 participated. These cut-offs are accurately reflected in Figure 1. We include Age_{cap} because any variation across adults by age is likely due to cohort effects rather than to developmental processes, which is not of current theoretical relevance to this paper. We expect sociocognitive changes to be important in childhood. For this reason, we expect Age_{cap} may be a better predictor than Age_{yrs}. For each measure of age, we tested both a linear model (Age), and a polynomial model (Age + Age squared). We use the R package 'MuMIn' (Barton, 2017) to calculate Akaike Information Criterion scores (AICc) and corresponding AICc weights for sets of models. We use corrected Akaike Information Criterion (AICc) to compare models because this information criterion penalizes overfitting on small samples, by correcting for the number of parameters relative to sample size (Burnham & Anderson, 2003). AICc weights estimate the probability that the model will make the best predictions on a new set of data, given the set of models tested, so are more meaningful than AICc scores. The weights reported in this section are for comparisons across the four possible age models (i.e. Age_{yrs}, Age_{cap}, $Age_{yrs} + Age^2_{yrs}$, $Age_{cap} + Age_{cap}{}^2$), separately for each site; for a comparison with models that do not include age, see Table 4.

For both Yasawan and Huatasaneño participants, the best-fitting model for age predicting irrelevant-action imitation is the polynomial with Age_{cap} (see Figure 2a). (For Yasawa, $AICc_{weight} = 0.93$; $R^2 = 0.22$; Age_{cap}: ß = 2.58, $p < .002$; Age^2_{cap}: ß = −2.20, $p < .008$. For Huatasani, $AICc_{weight} = 0.83$; $R^2 = 0.12$; Age_{cap}: ß = 2.06, $p < .009$; Age^2_{cap}: ß = −2.28, $p < .004$). Based on these results, we use $Age_{cap} + Age^2_{cap}$ for further analyses of individual variation in irrelevant-action imitation (see below). Taken together, these models indicate that the

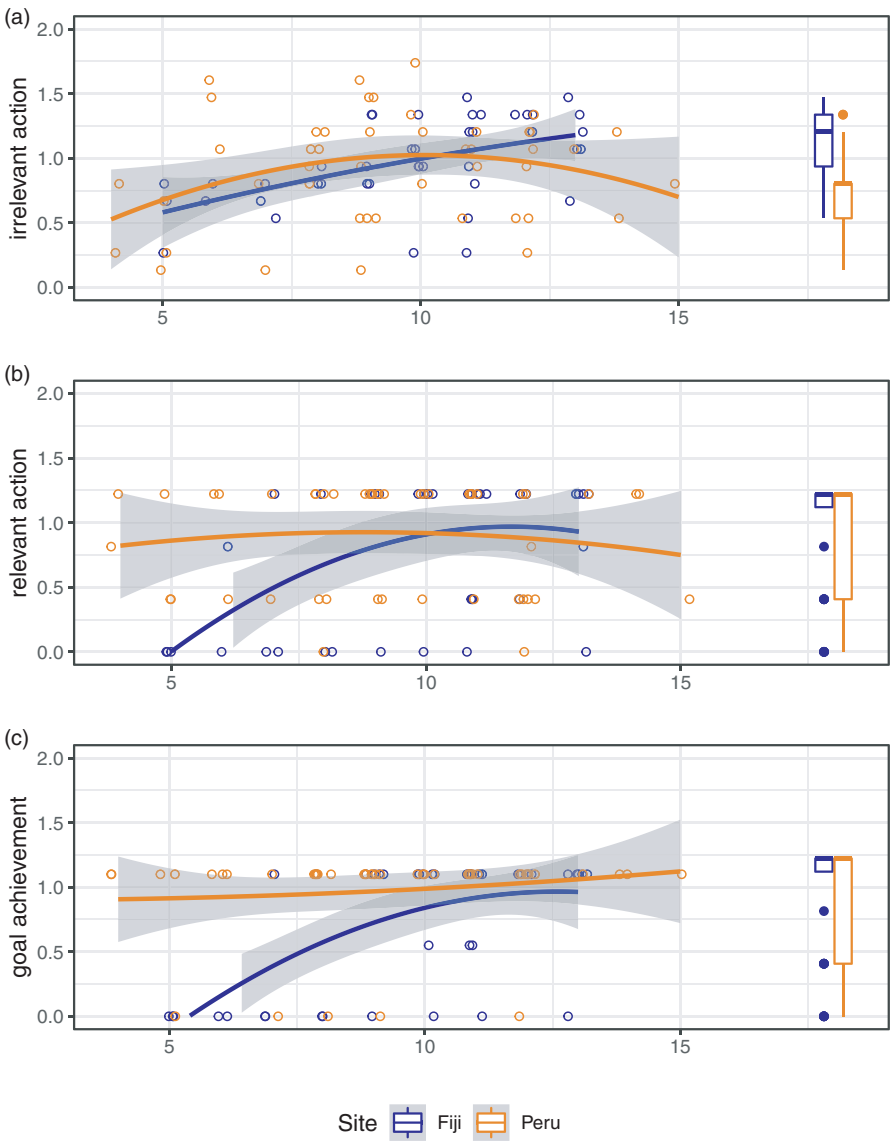


FIGURE 1 The line corresponds to predicted effects of age on (a) irrelevant imitation, (b) relevant imitation, and (c) goal achievement at each site for participants under the age of 18. Estimates are all derived from models with age in years (excluding adults) and with a squared age term. Shaded areas indicate the standard error of this predicted value. Points reflect scaled data for participants under 18; there were no Yasawan participants between the ages of 13–18 y and no Huatasaneño participants between the ages 15–18. Box plots show the mean rates for adults at each site, with boxes representing standard error and dots indicating outliers

TABLE 4 Shows the models ranked by AIC weights (Model #) reflecting the relative likelihood that each model predicting irrelevant-action imitation at Time 1 fits best

		Predictors				
Model #	AIC_w	1	2	3	4	Interactions
1	0.342	Age_{cap}, Age^2_{cap}	Site	Gender		(Age_{cap} + Age^2_{cap})* Site
2	0.252	Age_{cap}, Age^2_{cap}	Site	Gender		(Age_{cap} + Age^2_{cap})* Site, Gender * Site
3	0.134	Age_{cap}, Age^2_{cap}	Site			(Age_{cap} + Age^2_{cap})* Site
4	0.127	Age_{cap}, Age^2_{cap}	Site	Education		Education * Site
5	0.085	Age_{cap}, Age^2_{cap}	Site	Gender	Latency	(Age_{cap} + Age^2_{cap}) * Site, Gender * Site
6	0.045	Age_{cap}, Age^2_{cap}	Site	Latency		(Age_{cap} + Age^2_{cap})* Site
7	0.016	Age_{cap}, Age^2_{cap}	Site	Latency		(Age_{cap} + Age^2_{cap})* Site, Site * Latency
8	0	Age_{cap}, Age^2_{cap}	Site			
9	0	Age_{cap}, Age^2_{cap}	Site	Education		
10	0	Site				
11	0	Age_{cap}, Age^2_{cap}				
12	0	Age_{cap}, Age^2_{cap}	Education			
13	0	Age_{cap}, Age^2_{cap}	Education			(Age_{cap} + Age^2_{cap})* Education
14	0	Latency				
15	0	Education				

Note: Predictors and interaction terms describe the specifications of the models.
Abbreviation: AIC, Akaike Information Criterion.

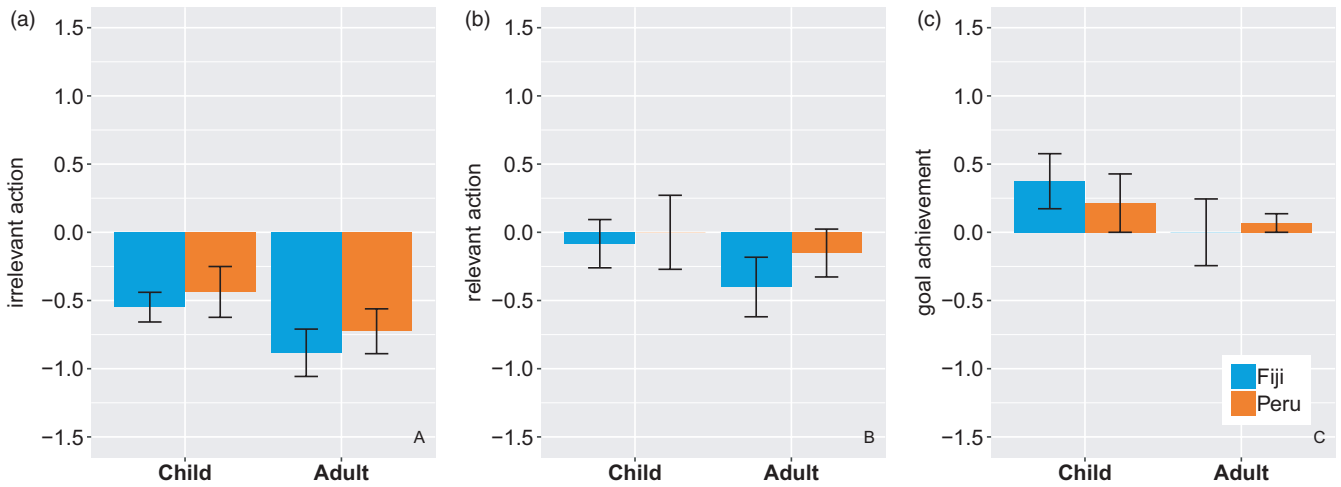


FIGURE 2 Shows the mean and standard error for difference of scaled scores (Time 1–Time 2) for (a) irrelevant-action imitation, (b) relevant-action imitation, and (c) goal achievement. Negative scores indicate a decrease in the behavior from Time 1 to Time 2, positive scores indicate an increase. The only difference scores that significantly diverge from zero are for irrelevant-action imitation, which decreases at Time 2 for all demographic sets of participants

shape of the developmental trajectory for irrelevant-action imitation has an inflection, that is, is not linear, at both sites (see Figure 2a). However, for the Yasawan population this represents a slower rate of increase in middle childhood (ages 8–10) up to the apex in adulthood. In contrast, for the Huatasaneño population, the parabolic function produces an apex at middle childhood, with a decrease in rates of irrelevant-action imitation to the lower levels observed among Huatasaneño adults (see Figure 1a).

The best-fitting model for age predicting relevant-action imitation in Yasawa is also the polynomial model with Age_{cap} ($AICc_{weight}$ = 0.95; R^2 = 0.18; Age_{cap}: ß = 2.69, $p < .002$; Age^2_{cap}: ß = −0.03, $p < .005$). In contrast, the best-fitting model for the Huatasani sample is a linear model using Age_{yrs} ($AICc_{weight}$ = 0.37). While this is the best-fitting model across the four age models, age has essentially no effect on the relevant-action imitation score ($R^2 < 0.01$; Age_{yrs}: ß < −0.01, $p > .73$).

The best-fitting model for age predicting goal achievement in Yasawa is the polynomial model with Age_{cap} ($AICc_{weight}$ = 0.99; R^2 = 0.29; Age_{cap}: ß = 3.45, $p < .001$; Age^2_{cap}: ß = −3.08, $p < .001$). In contrast, the best-fitting model for the Huatasani sample is a linear model using Age_{cap} ($AICc_{weight}$ = 0.35; $R^2 < 0.01$; Age_{cap}: ß = 0.06, $p > .54$) with the linear model using Age_{yrs} (AIC_{weight} = 0.29, $R^2 < 0.01$; Age_{cap}: ß < −0.01, $p > .95$) fitting nearly as well. While there is no statistically significant effect of age on either goal achievement or relevant action imitation for the Huatasaneño sample even in the best-fitting models, this does not indicate a failure by Huatasaneño participants to master the task. Rather, Huatasaneño participants copy relevant actions and achieve the goal of opening the box and obtaining the candy at similar rates regardless of age, and at similar rates as Fijian adults (see Figure 1a,b).

We tested for alternative explanations including whether gender and/or the timing of the testing session compared to the first participant at the site (latency) explain the effects of age and site on irrelevant-action imitation. The following models with an age variable all use Age_{cap} and Age^2_{cap} because our previous results showed these fit the data at both sites best. An exhaustive analysis of all possible models using these variables would be too extensive (and theoretically uninteresting) to show here. Instead we include a selection of models that either (a) add Gender, Latency, Site (and Education, see below) to the best-fitting Age-based model from above, or (b) test theoretically plausible alternative explanations (e.g., Education or Latency, but not Gender, may account for between-site differences). AICc weights reported in this section are based on a comparison across all models (see Table 4).

3.2 | Gender effects on irrelevant-action imitation

The video demonstrator, research assistants at both sites, and researcher administering the study in Huatasani were all women while in Fiji the researcher administering the study was a man. For this reason, we assess whether the gendered experimental context affected female and male participants differently, whether any such effect is different across sites, and whether it may account for inter-site differences. We do not have a strong a priori prediction of the direction of the differences. We found that including Gender does improve the model. Out of all the models tested, the best model includes Age_{cap} + Age^2_{cap}, Site, and Gender, with interactions between Site and age (see Table 4, Model 1). Male participants produce irrelevant actions at a slightly higher rate than do female participants (ß = 0.14, $p < .05$). $Gender_m$ is a dummy variable where male = 1 and female = 0, and $Site_H$ is dummy variable where Huatasani = 1, Yasawa = 0. The second-best model includes the same terms, plus an interaction between Site and Gender (see Table 4, Model 2). The interaction shows a stronger positive effect of being male in Yasawa, relative to Huatasani (see Data S1).

3.3 | Latency does not predict irrelevant-action imitation at Time 1

In this section we test whether irrelevant-action imitation rates were artefacts of recruitment timing. At both sites, the Time 1 phase was run over multiple days. To assess the possibility of participant pool contamination, we used *Latency:* days elapsed between the initial participant and each focal participant, as a measure of likelihood of contamination. We find no support for any effect of Latency. The univariate model with Latency is the second worst model tested (Table 4, Model 14). While three models including Latency do have AICc weights above zero (Table 4, Models 5, 6, and 7), the model fit improves with Latency removed (compare to Table 4, Models 2 and 3). The best-fitting model that does include Latency reveals a weak, non-significant negative effect of Latency on irrelevant-action imitation (R^2 = 0.24; Latency: ß = −0.02, $p > .81$; Age_{cap}: ß = 2.51, $p < .003$; Age^2_{cap}: ß = −2.16, $p < .009$; $Site_H$: ß = 0.65, $p > .35$; Age_{cap}*$Site_H$: ß = −0.56, $p > .60$; Age^2_{cap}*$Site_H$: ß = −0.01, $p > .99$, Sex_m: ß = 0.22, $p < .03$, Sex_m*$Site_H$: ß = −0.17, $p > .23$).

Hypothesis 2 Education does not predict irrelevant-action imitation.

Experience with formal education might increase irrelevant-action imitation if it trains people to repeat tasks carefully after instruction from an educational authority. On the other hand, it might decrease irrelevant-action imitation if it trains people to evaluate and solve problems in order to reach an end goal efficiently. We find no support for either of these hypotheses. None of the models that include Education improve on the best-fitting age and Site model, and Education as a lone predictor has the lowest AICc weight out of any of the models, meaning it fits the data worst of all the models (see Table 4, Model 15). The best-fitting model that includes Education also includes an interaction between Site and Education (see Table 4, Model 4. In these models, $Site_H$ is dummy variable for Site, with Huatasani = 1, Yasawa = 0.). This model shows a positive effect of Education on irrelevant-action imitation in Fiji, in contrast to a negative effect in Peru (R^2 = 0.23, Education: ß = 0.28, $p < .01$, Age_{cap}: ß = 2.52, $p < .0001$, Age^2_{cap}: ß = −2.51, $p < .0001$; $Site_H$: ß = −0.89, $p < .0001$), but it remains poorly ranked.

Hypothesis 3 There is no effect of script manipulation at Time 1.

We found no effect of Script version (standard vs. permissive) on irrelevant-action imitation at Time 1. This includes a model with Script alone as a predictor (as a dummy variable with Standard = 1, Permissive = 0) (R^2 = −0.001, ß = 0.07, $p < .38$), as well as a model with Script as a predictor along with Agecap, Age, and Site (R^2 = 0.15, Script: ß = 0.07, $p < .28$, Age_{cap}: ß = 1.93, $p < .001$, Age^2_{cap}: ß = −1.90, $p < .001$; $Site_H$: ß = −0.30, $p < .001$).

Hypothesis 4 Irrelevant action imitation is short-term.

Irrelevant-action imitation, but not relevant action imitation or goal achievement, decreases at Time 2. For each age set and site, we compared the mean irrelevant-action imitation, relevant-action imitation, and goal achievement scores for Time 1 with Time 2 using Paired t-tests (see Figure 2). We found that irrelevant-action imitation scores decrease from Time 1 to Time 2 for all demographic sets (Yasawa, Children: t = −5.04, *df* = 31, *p* < .001 and Adults: t = −5.09, *df* = 24, *p* < .001; Huatasani, Children: t = −2.35, *df* = 13, *p* < .05 and Adults: t = −4.41, *df* = 21, *p* < .001). In contrast, relevant-action imitation scores did not reliably decrease at Time 2 (Yasawa, Children: t = −0.47, *df* = 31, *p* > .64 and Adults: t = −1.84, *df* = 24, *p* > .07; Huatasani, Children: t = 0, *df* = 13, *p* > .99 and Adults: t = −0.87, *df* = 21, *p* > .39). This means participants at Time 2 were still likely to use the same door-opening techniques that they saw in the original video. In addition, goal achievement scores did not decrease at Time 2 for either site. If anything, children were somewhat more likely to achieve their goal on Time 2 (Yasawa, Children: t = 1.86, *df* = 31, *p* > .07 and Adults: t = 0, *df* = 24, *p* > .99; Huatasani, Children: t = 1, *df* = 13, *p* > .33 and Adults: t = 1, *df* = 21, *p* > .32).

4 | DISCUSSION

The studies we present above replicate a classic 'overimitation' paradigm, in two under-studied societies: among fisher-horticulturalists in Yasawa, Fiji, and agro-pastoralists in highland Huatasani, Peru. Unlike many studies of this phenomenon, we include a longitudinal component, as well as participants from a wide range of ages, in order to better examine how irrelevant-action imitation changes with development and across social and cultural contexts.

Challenging Hypothesis 1 and claims of universality, our work is the first to find population variation in the developmental trajectory of irrelevant-action imitation. The cross-sectional curve in Yasawa, Fiji, is similar to that documented in all other populations: the fidelity of imitation increases with participant age, plateauing at 'super-copying' among adults. However, Huatasaneño participants behaved differently. Specifically, Huatasaneño adults are the least faithful imitators of irrelevant actions among all the demographic sets studied here. Huatasaneño children increasingly imitate irrelevant actions until middle childhood. But at around age 10, Huatasaneño participants start decreasing irrelevant-action imitation until they bottom-out at adult levels of irrelevant-action imitation. This developmental trajectory has not been found in any other population studied to date.

The Huatasaneño trajectory cannot be explained by a population-specific deficit in understanding the task—Huatasaneño adults outperform Yasawan adults in solving the puzzle box to obtain the reward. This empirical finding also makes it unlikely that the between-site differences are due to the demonstration video being played once for Huatasaneño participants and twice for Yasawans: if seeing the video twice affected imitation accuracy, it should be the Huatasaneño participants who showed lower levels of imitation and goal achievement, rather than the Yasawan participants.

One potential explanation is that formal education shapes propensity to imitate faithfully (Berl & Hewlett, 2015), our Hypothesis 2. Both study populations have similar valuations and styles of formal education, focused on obedience and rote memorization, but large within-population variation in educational attainment. Our statistical analyses confirm that neither between- nor within-population differences in formal education predict fidelity of imitation. In fact, education does not add any predictive power to our models, on top of age and site. Our analyses do show an interaction between education and site, and the direction of the effect is consistent with that of age: older participants and participants with more education copy more irrelevant actions in Fiji, and fewer in Peru. This suggests that education's effect is consistent with broader socialization processes in a given context, rather than in contrast to them. Finally, we can also rule out education-related cohort effects as a cause of the developmental trajectory we find in Huatasani, because our analyses collapse all adult ages to a single value (Age_{cap}), and our results show that including an interaction between age and education does not improve the model's fit.

Instead, we propose that the between-site difference is due to development playing out in different sociocultural contexts with different social histories. We suspect the most relevant between-site difference for this study is local attitudes toward North American/Western European or 'white' foreigners. Among many Indigenous Fijians, colonial history is viewed relatively positively (Lal, 1992), as an improvement upon pre-colonial times. In the present day, visitors – especially highly educated *vavalagi* ('white' people from English-speaking nations) – bring material benefits to Fijian villages and, through the tourism industry, to the country as a whole. As a result, there is an ethos in post-colonial Fiji that emphasizes hospitality toward, and collaboration with, such visitors. This nostalgic view of a colonial era is not particular to Fiji (Bissell, 2005), nor does it necessarily accurately reflect a positive history of colonial rule. For example, there is much nostalgia among black, rural residents of South Africa, even for periods of apartheid rule (Reed, 2016). In contrast, a different attitude toward colonial history and outsiders prevails in the highlands of Peru, where many people have ambivalent feelings toward 'white' outsiders. Such outsiders may be prestigious authorities, but also coercive extractors of local resources – targets of respect, but also fear and suspicion. This ambivalence is grounded in a colonial and post-colonial history that involved enforced labor in mines (Dell, 2010), brutal suppressions of anti-Spanish rebellions (Walker, 2014), homegrown Maoist insurgencies and national responses that tore apart peasant communities (Kent, 1993), and foreign mining concessions that brought jobs and contamination. These anxieties and fears are reflected in concerns about *pishtacos* and *kharasiris*; creatures that present as pale strangers who roam around cutting people and taking their fat, either to sell or subsist on (Weismantel, 2001).

The inherently social nature of an imitation task (Over & Carpenter, 2012a) means that local stances toward outsiders may drive participants' approaches to the study itself. While the

demonstrations were video-mediated, there was a social context that immediately included two experimenters and that more broadly involved researchers living in the community and recruiting participants for studies. At both sites, the researchers occasionally pay show-up fees to participants, but did not directly compensate participants for this task. Instead, researchers sought to provide community-level benefits for allowing research to take place in their communities, for example through donations to community causes such as school or church group fundraisers. The long-term social relationship between the researchers and the local community is the main reason people choose to participate in this research at all. In Yasawa, this is done primarily for ethical reasons – to avoid any undue pressure for participation in cash-poor communities – but it also has implications for the interpretation of research at both sites.

We think this social context, framed by the researchers' relationships with the study populations, helps to explain the between-site differences in our results. Yasawan adults, viewing the task as a cooperative interaction with the researchers, adhere more strictly to the implicit and explicit social demands of the study (e.g., 'watch this and copy it'), and reproduce actions faithfully. This may be similar to the perspective of the (better-represented) population of Western parents who voluntarily visit university laboratories in order to enroll their children in research studies. In contrast, Huatasaneño adults interpret the study as having potential conflicts of interest with the foreign researcher, and in the end avoid copying irrelevant actions as if they are 'trick' questions. Taken as a whole, ethnographically contextualizing our results suggest that the divergent developmental trajectories are caused by differences in social motivations in differing post-colonial contexts, not by variation in ability.

This interpretation gains further support based on when the between-site differences emerge. Children at both sites copy with increasing fidelity, up until middle childhood, when a downward shift occurs among Huatasaneño participants. Middle childhood (around 8–10 y.o.) is a period during which children across cultures begin to be tasked with household responsibilities, performing gender roles, adhering to social norms, and generally being accountable to adult-like standards of conduct (Boyette, 2013; Lancy & Grove, 2011; Rogoff, Sellers, Pirrotta, Fox, & White, 1975). It is also when children begin to take a critical, evaluative stance toward social learning beyond viewing demonstrators as either good or bad sources of information (Mills, 2013). The shift away from irrelevant-action imitation among Huatasaneño participants happens in this same developmental phase, and is consistent with Huatasaneño children adopting adult-like attitudes about ethnolinguistic groups (Moya, 2013).

For this study, this remains a post hoc explanation of the differences we documented, but it suggests future research directions. Future studies could collect data on individual participants' attitudes toward outsiders, using measures such as time spent outside the community, experience with wage labor, or general parochialism. Another alternative is to manipulate the demonstrator or experimenter's identity (Harris & Corriveau, 2011; Kinzler, Corriveau, & Harris, 2010; Kinzler, Dupoux, & Spelke, 2007) and/or compare the trajectories for populations in more and less parochial cultural contexts. In more parochial contexts, demonstrator/experimenter identity should make a greater difference, and the differences should appear in middle childhood. We note that, while not equivalent to intergroup attitudes, several studies (e.g., Chudek et al., 2016; McGuigan & Robertson, 2015) have failed to find effects on irrelevant-action imitation of measured attitudes toward models.

A second major finding of this study is the drop in irrelevant-action imitation at Time 2, across all demographic sets, supporting a short-term function (Hypothesis 4). This study is, to our knowledge, the first to assess the durability of irrelevant-action imitation within subjects after a substantial delay. However, the findings do accord with several other studies. Simpson and Riggs (2011) found that delaying the test phase for a week selectively reduced irrelevant-action imitation between-subjects. McGuigan and Robertson (2015) found a selective reduction in irrelevant-action imitation during a test phase placed shortly after the study had been declared over.

Because relevant-action rates in our study were unchanged at Time 2, a general process of 'forgetting' the initial demonstration does not explain our results. More specific memory biases, however, could be consistent with our results. For example, if participants remember relevant and irrelevant actions in different ways to begin with (Simpson & Riggs, 2011), or if participants recall only the actions that happen just prior to goal achievements, the same pattern might emerge. However, the order of events can serve as a cue to causal relationships (Bullock & Gelman, 1979). As such, it may be that better memory of events that immediately follow one another is less of an alternative explanation than it is a hypothesis about a possible mechanism that allows learners to distinguish relevant (e.g., causal) actions from irrelevant actions.

Even after a month, and after only one sitting with the artifact, participants at Time 2 opened the box, obtained the reward, and did so by matching the relevant actions in their version of the demonstration, all while discarding the irrelevant actions. Participants succeeded at the task at the same, or higher, rates than at Time 1. This suggests that the instrumental functions of irrelevant-action imitation may be limited to exploratory learning about novel, causally opaque artifacts, without directly stimulating long-term causal encoding (Lyons et al., 2007). Our results suggest that, without additional cues to conventionality such as conventional language or multiple demonstrators, the social functions of irrelevant-action imitation may be limited to short-term affiliation, as proposed by Over & Carpenter (Over & Carpenter, 2012a). This is in contrast to 'overimitation' as a direct cause of long-term encoding of arbitrary conventions (Kenward, 2012; Kenward et al., 2010; Keupp et al., 2013; Watson-Jones et al., 2014, 2016).

Our permissive script manipulation had no effect on the fidelity of irrelevant-action imitation, as would be expected if the behavior indicated long-term instrumental or norm learning (Hypothesis 3). Lyons et al. (2007) similarly found no drop in irrelevant-action imitation following instructions not to copy the 'silly and extra' actions modeled. Likewise, irrelevant-action imitation has appeared robust to permissive language in several previous studies (e.g., Chudek et al., 2016; Moraru, Gomez, & McGuigan, 2016), although in those studies it was not experimentally manipulated. It may be

that irrelevant-action imitation is not intrinsically motivated by a norm learning mechanism. Instead, such a mechanism could be engaged with conventional language or other cues (see, e.g., Keupp et al., 2016, 2013; Legare et al., 2015; McGuigan & Robertson, 2015; Watson-Jones et al., 2014; Watson-Jones et al., 2016) that overdetermine imitation of irrelevant actions, and perhaps trigger long-term norm encoding. We therefore remain cautious in generalizing our results. It is possible that the short-term affiliative function of irrelevant-action imitation is particular to the puzzle box task we used, and that the transparency of the task (literal and figurative) reduces the potential instrumental benefits of faithful social learning. For real-world domains of learning, where tasks vary in transparency and in difficulty, we would expect variation in patterns of irrelevant-action imitation.

5 | CONCLUSION

This study focused on the sociocultural context in which the experiment took place in order to compare the responses of participants from two understudied non-Western populations with whom the researchers have extensive experience. Our results document age-dependent, between-population differences in irrelevant-action imitation, and have theoretically meaningful implications. We found that the social context of the study may have important effects on participants' reproduction of apparently irrelevant actions. Using a Time 2 follow-up, we show that participants in both populations do distinguish between relevant and irrelevant actions, selectively dropping the latter over time. Relying more heavily on functionalist approaches, in this case cultural evolutionary theory, points to directions for future research. In particular, this shifts the research question from whether or not 'overimitation' is universally present across human populations, to a focus on describing and explaining its variability across social and cultural contexts. For example, future research should ask how the form of imitation maps onto its function, in a particular environment. This approach could be applied to many psychological phenomena, and may even help to shed light on one source of the replication crisis in Psychology: results can vary according to sociocultural context and framings that differ across geographic location and over time (Stroebe & Strack, 2014).

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CONFLICT OF INTEREST

The authors have no conflict of interest to report.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author, Michelle Ann Kline (makline@sfu.ca) upon reasonable request.

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SUPPORTING INFORMATION

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