Do Minds Switch Bodies?

Dualist interpretations across ages and societies.

Maciej Chudek[1], Rita McNamara[2]*, Susan Birch[3], Paul Bloom[4], Joseph Henrich[5]

1: School of Human Evolution and Social Change, Arizona State University

2: Centre for Applied Cross-Cultural Research, School of Psychology, Victoria University of Wellington, NZ

3: Department of Psychology, University of British Columbia

4: Department of Psychology, Yale University

5: Department of Human Evolutionary Biology, Harvard University

* Corresponding Author

Abstract

Researchers explain cultural phenomena ranging from cognitive biases to widespread religious beliefs by assuming intuitive dualism: humans imagine minds and bodies as distinct and separable. We examine dualist intuition development across two societies that differ in normative focus on thinking about minds. We use a new method that measures people's tendency to interpret ambiguous stimuli using mind-body dualist thinking. We recruit 180 Canadian children (2-10 yrs.) along with 42 Indigenous iTuakei Fijian children (5-13 yrs.) and 38 Indigenous iTaukei Fijian adults (27-79 yrs.) from a remote island community. Participants tracked a named character within ambiguous animations that could be interpreted as a mind-body switch. Animations vary 'agency cues' participants might rely on for dualistic interpretations. Results indicate early emerging dualistic inclinations across populations and reliance on 'agency cues' of body proximity and appearance of eyes. 'Agency cues' increase dualist interpretations from 10% to 70%, though eyes mattered more for Westernized participants. Overall, statistical models positing dualist interpretations 'emerge early and everywhere' fit our data better than models positing dualism 'develops gradually with exposure to Western cultural traditions.' Fijian participants, who normatively avoid focus on minds, offered even more dualistic interpretations when they had less Western cultural exposure (via formal education).

Keywords

Dualism, Mind-perception, Body-switching, Developmental, Cross-cultural, Psychology

Word count: 6539

1. Introduction

Many people behave as though they are mind-body dualists. Beliefs in souls, the afterlife (Atran & Norenzayan, 2004; Boyer, 2001), mindless bodies (zombies), bodiless minds (ghosts, spirits), and minds entering new bodies (Cohen, 2007; Cohen & Barrett, 2008) are common across societies and history. We place value on "genuine" artifacts (Bloom, 2004) as though infused with their owners' essence. In reasoning about 'psychological' versus 'physical' disorders, even highly trained medical experts show reasoning biases that are inconsistent with medical science (Ahn, Proctor, & Flanagan, 2009). Children (Notaro, Gelman, & Zimmerman, 2001; Schulz, Bonawitz, & Griffiths, 2007) and adults (Ahn et al., 2009) struggle to draw causal connections between mind-related and body-related phenomena. Cross-cultural research suggests adult intuitions about disembodied minds are strikingly similar across societies (Cohen, Burdett, Knight, & Barrett, 2011), while young children sometimes expect minds to persist after bodily death (Astuti & Harris, 2008; Bering & Bjorklund, 2004). Historically, ancient Chinese texts show a dualist signature despite a reputation for mind-body monism (Slingerland & Chudek, 2011). Scholars invoke dualist intuitions to explain religion (Bloom, 2007), morality (Gray, Young, & Waytz, 2012; Haidt & Graham, 2007), public reactions to science (Bloom & Weisberg, 2007), and the disconnect between the sciences and humanities (Slingerland, 2012). Despite apparent ubiquity and theoretical prominence, we still know little about mind-body dualism's developmental origins or trajectories.

Many theories propose explanations for dualistic inferences – though many disagree on their evolutionary and developmental origins, their instantiation in the brain, and their impact on thought. We lack substantial empirical evidence on whether, when, and how dualist intuitions develop; how they change with age; and whether these patterns vary across societies. The

challenge of measuring an abstract cognitive inclination like 'the tendency to conceive of minds as separate, or separable from bodies' across populations and ages calls for minimal reliance on language and culture-specific concepts. Young children are often not able to understand complex experimental materials or follow complex verbal instructions. Young children are also inexperienced at introspecting on and articulating their own thoughts. Developmental comparisons being difficult enough, it is harder still to measure development across societies. People everywhere may offer culturally conventional answers to abstract questions about 'minds;' verbal questions are subject to linguistic conceptual baggage. Measuring such abstractions requires minimal verbal instruction, and certainly no verbal instruction about concepts like 'mind.' It requires materials that people of all ages everywhere can understand with minimal language, plus a response method that taps potential dualist intuitions that is accessible to all ages.

We here contribute a method of measuring dualist inclinations that, we argue, fits this bill. Our 'body switch interpretation' method requires participants to interpret the goal-directed motion of animated shapes, assign them names, and point to them. Participants see simple animated shapes moving on a screen (something even infants can grasp). Participants are asked to index a character with a name; names carry minimal conceptual baggage, are culturally ubiquitous, and are among children's first words. Finally, they respond by pointing – a behavior commonly accessible by the first birthday (Callaghan et al., 2011).

We describe our method and its results within a sample of different ages from two very different societies. We deliberately avoid committing to any one interpretation of dualism. Rather, we present evidence that may help advance existing theory. Our evidence, which describes proclivity to assign a named identity to a new body, is relevant whether dualism is

evolved, modular, individually learned, culturally transmitted, entails body-switching, entails the existence of mind-substance, has religious implications, etc. As such, our evidence might be relevant to proponents of many different theories of dualism. We focus on one particular dimension: the degree to which dualist reasoning develops through cultural input. Our sample allows examination of how dualist thinking changes with a) age in two different societies and b) exposure to Western education. This insight is valuable whether dualism is a maturationally natural concept, a culturally evolved equilibrium, or a philosophical certainty arrived at by reason alone.

We compare the relative fit of our data to the predictions of two broad hypotheses:

Intuitive Dualism (ID): Dualist intuitions emerge early and reliably in children everywhere. They change little with development or exposure to Western cultural influences. Patterns of body-switch perception should vary little across populations or ages.

Culturally Acquired Dualism (CAD): Dualist intuitions require substantial cultural input, and develop gradually with exposure to specific cultural ideas, worldviews, or the assumptions implicit in language or semantic networks.

2. Methods

We measured likelihood of inferring a mind had moved from one body to another after seeing ambiguous, animated stimuli. This inference should be accessible to dualists (who consider minds and bodies separate/ separable) but far-fetched to non-dualists. Participants watched multiple animated scenes of a pentagon approaching a cake. The pentagon was named ("This is Penny"). After each scene, we asked participants to "point to Penny." Participant saw the same first three scenes. These were relatively unambiguous—we expected both dualists and non-dualists to point to the pentagon. The fourth, a critical 'Testing Scene,' varied and could be

interpreted as depicting the pentagon's mind moving into a new, triangular body. Our measure of dualist intuitions was the rate of pointing to the triangle as "Penny."

First Scene: Participants initially see a pentagon and a cake in opposite corners (First Scene, Figure 1). The pentagon and cake begin in these positions in all subsequent scenes. The experimenter says: "This is Penny, she really likes cake." The animation shows the pentagon gazing towards, then moving towards, and then seeming to take a bite out of the cake. The experimenter says: "Point to Penny." Young participants could receive additional encouragement ("It's OK, you can point") if required. The experimenter repeats this request to "Point to Penny" at the end of all subsequent scenes.

[insert Figure 1]

Maze Scene: A maze separates the pentagon and cake (Maze Scene, Figure 1). The pentagon gazes towards the cake, then navigates the maze to reach it. This scene establishes that pentagon Penny will move toward the cake goal despite obstacles.

River Scene: The pentagon's path is blocked by a river. A large square with eyes is motionless beside the cake on the other side. The pentagon gazes and moves towards the cake until it is stopped by the river. It moves back and forth along the river and eventually moves away. This scene establishes that pentagon Penny can be blocked from the cake goal. This scene also provides an estimate of the rate of pointing to anything other than the pentagon as 'Penny' for reasons other than dualist inferences (our *noise rate*).

Testing Scene: Pentagon Penny is again blocked from the cake goal. This time, there is a potential dualist solution: switching bodies to a smaller entity that can pass through the barrier. The pentagon's path to the cake is blocked by a wall with a gap smaller than its body. A small triangle stands motionless on the pentagon's side of the gap. The pentagon gazes and moves

towards the cake until it is stopped by the gap. It moves back and forth in front of the gap. The pentagon eventually moves away from the gap, stops moving, and stops gazing towards the cake. A moment later the triangle becomes animate, gazes towards the cake, then proceeds through the gap to the cake.

We manipulate how our ambiguous scenes might cue a mind-body switch across five conditions (Figure 1, bottom row and Table 1) that draw on existing agency cues research:

Self-propelled motion (Luo & Baillargeon, 2005; Premack, 1990): The pentagon's apparent self-propelled motion ceases just before the triangle's starts; used in all scenes.

Equifinality and efficiency of behavior (Csibra, Gergely, Bíró, Koós, & Brockbank, 1999; Gergely & Csibra, 2003; Gergely, Nádasdy, Csibra, & Bíró, 1995): The triangle takes up the pentagon's established goal (the cake); explored in *Near* and *Far* conditions.

The presence of facial features, especially eyes (Beier & Spelke, 2012; Farroni, Csibra, Simion, & Johnson, 2002; Hamlin, Wynn, & Bloom, 2007; S. Johnson, Slaughter, & Carey, 1998; Phillips, Wellman, & Spelke, 2002; Woodward, 2003): Explored in -*Eyes* and -*Bowtie* conditions.

The **Far** and **Near** conditions manipulated, respectively, whether the pentagon moved *away from* or *towards* the triangle before becoming motionless. 'Movement towards' should cue body-switching inferences by (1) suggesting Penny represents the triangular body as a proximate goal which it efficiently pursues, and (2) possibly satisfying intuitions that switching bodies requires close physical proximity.

The **-Eyes** conditions used salient eye shapes, a cue used even in early infancy (Hamlin et al., 2007). In these conditions, the pentagon initially has eyes while the triangle does not. The eyes disappear when the pentagon stops. A few seconds later, a pair of eyes appear on the triangle. In

the without-eyes cues conditions, the eyes do not disappear or appear on either shape but are present on both for the entire video (and thus cannot operate as a distinguishing cue). We ran the both the **Near** and **Far** condition with and without eyes cues. Conditions with the eyes disappearing from one shape and appearing on the other are labelled with the -Eyes suffix.

To establish that eye cues mattered, a **-Bowtie** condition showed a bowtie shape disappear from one shape and appear on the other (Near-Bowtie condition, Figure 1E).

2.1. Participants

We recruited participation in two societies: In Vancouver, Canada, we tested 180 children (2-10 yrs.) at the science museum. Since 92% of developmental studies are done among WEIRD children (Nielsen, Haun, Kärtner, & Legare, 2017), the site provides a comparison to the majority of developmental data. We compare this population to Indigenous iTaukei Fijians from Yasawa Island, Fiji (hereafter, Yasawans). Participants were randomly assigned to conditions; mean ages, age ranges and sex distributions are presented in Table 2.

[insert Table 2]

Our Yasawan participants provide an illuminating comparison for several reasons. First, as a largely traditional, small-scale society in the Pacific, Yasawans grow up in a context of social norms that discourages inference about other's mental states as the causes of their behavior. Ethnographers document such norms around the Pacific as 'Opacity of Mind' (Duranti, 2015; Lillard, 1998; Luhrmann, 2011); this cultural context leads to very different ideas about the link between mind and observable behaviors. Behaviorally, people living in these Opacity of Mind contexts avoid mental state focus in several ways: children respond to false belief tasks that ask them to predict a character's action based upon a wrong belief at later ages (Barrett et al., 2013; Mayer & Trauble, 2012); adults choose harsher responses to accidents (negative outcomes

without negative intent - Barrett et al., 2016; McNamara, 2016); and real-life offenses are dealt with based on consequences resulting in relationship damages rather than intentions (Duranti, 2015). This mental state avoidance implies that people in Opacity of Mind contexts may also be less likely to track mental states moving across bodies. If mind-body dualism is indeed a core part of our social cognition, evidence that Yasawans make dualist inferences would also indicate that mind-body dualism is robust to cultural influences that might suppress its expression.

Our Yasawan participants also help us account for effects of Western media, discourse, and education. 1) Media: Unlike Vancouver children, Yasawans at the time of the study had no computers, children's books, reliable electricity, or manufactured toys. The few televisions present had poor reception and were used mostly by men to watch rugby. 2) Discourse: our Yasawan sample allows us to test whether these intuitions are facilitated by exposure to highly analytic (Nisbett, Peng, Choi, & Norenzayan, 2001) European societies, with their long histories of conceptualizing the world as composed of distinct, separable elements. Dualist assumptions may be so deeply embedded in Western discourse that we cannot help but gradually adopt them. By contrast, Yasawans tend toward more holistic, relationship-focused thinking (Brison, 2007). 3) Education: In our work, whenever possible, we aim to test ages ranging from the youngest who can understand the task to the oldest. Thus, we considered recruiting adults in both Vancouver and Yasawa. However, in Vancouver, it became clear adults found the task too silly and transparent. Unfamiliar with such media, 38 Yasawan adults readily engaged in our task (100% of those asked). Yasawans in our study communities vary substantially in their exposure

to Western-style schooling, ranging from zero to 12 years. This provides opportunity to examine effects of exposure to formal Western education.[1]

3. Results

Did participants make dualist inferences? Yes.

The rate of pointing to the triangle as Penny varied from 10% to 72% across conditions. Table 2 and Figure 2 present these rates and their 95% confidence intervals.

To test the hypothesis that some participants inferred "Penny" was in the triangular body, we need an estimate of the rate they would have pointed to the triangle without making this inference (due to e.g., inattention, confusion, or boredom). Our best source of information about this 'noise rate' is the non-pentagon pointing rate in the previous scenes.

All participants pointed to the pentagon in the first two scenes. In the River Scene (Figure 1) 12/272 (~4.4%) participants pointed to the square (or, in two cases, the cake). Yasawans and Canadians did not differ in this rate ($p = 0.5$), so we base our inferences on the pooled estimate.

In all but one condition, rates of pointing to the triangle differed dramatically from this River Scene 'noise rate;' these differences were well outside plausible error by binomial sampling (see Table 2). Only in the Far condition was it plausible that observed triangle-pointing rate (twice the noise rate) and noise rate were instances of the same population rate ($p = 0.37$), suggesting substantial dualistic inclinations in all other conditions.

---

[1] All research and consent procedures were reviewed and approved by the University of British Columbia's Behavioural Research Ethics Board. In Vancouver, parents gave their signed consent and children their verbal assent to participate. In Yasawa, participants only gave their verbal consent because of variable literacy. Yasawan adults' consent was obtained in three phases: first from the village elders and chief, then from each household, and finally from each participant prior to participation. Yasawan parents gave consent for their children to participate and Yasawan children assented. Consent and assent were documented on our data sheets. No data was collected without all three levels of consent and we maintained contact with the villagers to allow them to revoke their data if they so choose after the study ended.

Variability of pointing across conditions suggests agency cues were triggering dualist inferences. We test the effects of these cues along with effects of demographic factors using logistic regression. We regress whether a participant pointed at the triangle ('dualist interpretation') based upon the agency cues they saw (proximity, eyes), their age, population (Canadian vs. Yasawan), and exposure to Western education (Yasawan adults only). Parameter estimates for these models are summarized in Tables 3, 4, and 5. We summarize their qualitative insights and the relative fit of these patterns to the models implied by two hypotheses about the origins of dualism: that it emerges early everywhere (Intuitive Dualism, ID), and that it emerges gradually with cultural exposure (Culturally Acquired Dualism, CAD).

Did agency cues cause participants to make more dualist inferences? Yes.

We regressed triangle-pointing rates on both eye- and proximity-cues controlling for age and sex. Canadian children were 2.85 times (*OR*.95CI [1.31, 6.42], $p = 0.009$) more likely to indicate a body switch with proximity-cues. Eye-cues, eyes on Penny disappearing and eyes on the triangle appearing, made Canadian children 9.26 times (*OR*.95CI [4.09, 22.80], $p < 0.001$) more likely to indicate a body switch. The eyes-cue made a significant contribution to Canadian children's body switch detection; in contrast, the Near-Bowtie condition did not significantly differ from the Near condition (*OR* = 1.33, .95CI [0.42, 4.35], $p = 0.63$). Though Yasawan participants indicated body switching, eye-cues did not make a significant contribution. We found no significant differences in the effect of eyes between our two Yasawan conditions (Near and Near-Eyes) for children (*OR* = 1.86, .95CI [0.52, 7.05], $p = 0.35$), adults (*OR* = 1.61, .95CI [0.44, 6.22], $p = 0.48$) or both combined (*OR* = 1.78, .95CI [0.72, 4.49], $p = 0.22$); though in all cases eye cues increased the triangle-pointing rate.

[insert Table 3]

Did older participants make more dualist inferences, suggesting an effect of learning? No, they made (non-significantly) fewer.

Table 3 shows a trend toward *decreasing* odds of indicating a dualist inference as Canadian and Yasawan children age, while Yasawan adults show a trend toward *increasing* odds with greater age. This suggests some non-linearity in the effect of age; we therefore fit both a quadratic and exponential curve to age for the two populations separately and together. Both models fit the data nearly identically well, so both are shown in Table 4. The quadratic formula estimated from the full sample[2] predicts that a 5-year-old Yasawan child in the eyes condition has an 84% probability of indicating a body switch, while a 25-year-old Yasawan in the same condition has only a 59% probability and a 50-year-old Yasawan has a 64% probability.

[insert Table 4]

To put a finer point on this, how many years of exposure to dualist beliefs, norms, and practices would be required to shift a population from our estimated non-dualist error rate (4.4%) to making the dualist inference half the time (50%)? We evaluate three plausible predictions a CAD theory could make: an enculturation process that is relatively fast (5 years, $\beta = 0.62$[3]), medium-paced (10 years, $\beta = 0.31$) or slow (20 years; $\beta = 0.15$). The likelihood of observing our data (Figure 3) is far smaller under these three exemplar CAD predictions than ID's prediction:

---

[2] For simplicity, we calculate the predicted probabilities of indicating a body switch (pointing to the triangle as Penny) from the quadratic formula from the full data set, though the predictions from the exponential model are almost identical. The biggest difference between the two models is for younger adults in Yasawa. The quadratic model predicts a 59% probability that a 25-year-old Yasawan will indicate a body switch in the eyes condition, while the exponential predicts a 69% probability for the same individual. We do not have sufficient data to detect a difference between these models with age alone. However, as we discuss with the results on exposure to Western culture through years of formal Western education, adding education to these models adds significant prediction above-and-beyond age. Education also tends to be highest among young adults, which may indicate that the quadratic model may be a better theoretical model for this data.

[3] An increase from a 4.4% pointing rate to a 50% rate is about a 22-fold increase in the odds of pointing. Dividing the natural logarithm of this odds ratio over the number of years over which the change occurs yields the predicted logistic regression coefficient.

that dualist inferences reliably develop early in everyone. Age therefore should have little effect on the likelihood of dualist interpretations.

[insert Figure 3]

Did Western participants make more dualistic inferences? No, they made fewer.

Overall, Yasawan children pointed to the triangle 2.91 times more often than Canadians (*OR*.95CI [1.11, 8.04], $p = 0.03$). In the Near-Eyes condition, both Yasawan and Canadian children pointed at similar rates (*OR* = 1.08, .95CI [0.26, 4.90], $p = 0.92$). However, Yasawan children were 23.69 times more likely (*OR*.95CI [2.92, 344.21], $p = 0.007$) to indicate a body switch in the Near condition (Figure 2, Table 3).[4]

Did participants with more exposure to Western education make more dualist inferences? No, they made fewer.

We examine education by adding education to both our quadratic and exponential models for the Yasawan sample (see Table 5). For both, the triangle-pointing odds were *reduced* for each year of formal education, above-and-beyond age. Each additional year of education increased the chance of *not* indicating a body switch by around 27%. Eyes increased odds of indicating a body switch (quadratic age: *OR* = 2.56, p = 0.08; exponential age: *OR* = 2.56, p = 0.08). The relationship between eyes cue and education depended on whether the participants were adults or children, as captured by a three-way interaction (*adulthood X condition X education*, $\beta = -1.32$, $p = 0.05$). For adults, each year of education increased odds of indicating a body switch when the eyes moved to the triangle by 42%, though this was not measured with sufficient precision to be

[4] One way to examine the relative fit of CAD and ID is to consider three possible variants of CAD. Experience living in a Western, Cartesian-influenced society (Canada) could cause the odds of switch-perceiving to increase by a small amount (*OR* = 1.2). The likelihood of this CAD model, given our data, is three times smaller than ID's prediction of no cultural difference. Strong variants of CAD fare even worse. A medium (*OR* = 2) cultural effect is 180 times less likely, a large one (*OR* = 3) is about fifteen thousand times less likely.

statistically significant as a simple effect (Education for adults in the Near-Eyes condition: *OR* = 1.42, .95CI [0.08, 2.70], $p = 0.24$). On the other hand, more education marginally *decreased* the odds of adult Yasawans indicating a body switch when the eyes did not move to the triangle (Education for adults in the Near condition: *OR* = 0.44, .95CI [0.10, 0.87], $p = 0.09$). Put simply: more educated Yasawans were *less* disposed to offer a dualist interpretation of the stimuli, particularly adults in the absence of eye-cues.

Consider how much formal education would be required to shift the switch-perceiving rate from the baseline noise estimate (4.4%) to just 50%. This could happen relatively slowly (15 years), at a medium pace (7 years) or quickly (3 years). The data we observed are many thousands of times less likely under any of these modes than ID's prediction (Figure 4).

[insert Figure 4]

3. Discussion

Dualist inclinations might arise as a byproduct of the distinct evolutionary phylogenies of our cognitive systems for tracking agents' goals and perceptual access (Bloom, 2004; Csibra & Gergely, 1998; S. C. Johnson, 2003; Leslie, 1994; Low & Perner, 2012); or, they might be a cultural contrivance invented by French philosophers (Descartes, 1985). Mind-body dualist inferences may emerge due to first person experience of what things in this world are like; from learning about cultural representations like ghosts, souls, etc.; or be subtly shaped by exposure to Western concepts and education. Using the method described here, we hope to provide evidence that is relevant to all of these possibilities. More specifically, our results help sketch how do dualist intuitions change with age, and how sensitive are they to cultural input? They also help indicate which visual cues cause people to make dualist inferences, and how might these vary across populations.

Our participants offered more dualist interpretations of ambiguous stimuli (pointing to a named individual—'Penny'—in a new body) when scenes depicted deliberate movement of the old body towards the new one and the transfer of eyes between the bodies. Tendency toward this interpretation did not vary between sexes, did not increase with age, and became more selective with increased exposure to Western culture. Our data provide evidence that young children make dualist inferences, even if these cues are entirely non-verbal animations of abstract shapes with eyes, and even if they've had little or no exposure to Western media or education. We sketched hypotheses to act as markers between dualist inferences requiring 'no cultural input' (Intuitive Dualism or ID) and 'lots of cultural input' (Culturally Acquired Dualism or CAD).[5] Our data showed dualist intuitions did not substantially differ with age, favoring Intuitive Dualism.

Our adult Indigenous iTaukei Fijian participants, who had received dramatically different amounts of Western schooling, also speak to whether dualist thinking requires Western education. Our data disfavor theories of dualism as a Western cultural innovation since, if anything, iTuakei Fijian adults with more Western education made *fewer* dualist inferences. This is particularly noteworthy given the Indigenous iTaukei Fijian cultural context of social norms that discourage inferences about others' minds. The combined evidence that children readily make dualist inferences and adults make these inferences *less* with more Western cultural exposure through education suggest that dualistic inference may indeed be cross-culturally consistent. If norms against mental state inference were the source of this reduction in dualistic inference, we would expect the opposite – that more Western education would then increase dualism. These data provide a glimpse into how Western enculturation via formal Western

[5] Keep in mind that we are not advocating for or trying to disprove either of these positions. Rather, they are rhetorical devices to more easily discuss about what the regression coefficients in our models say about the age- and education-dependence of dualist inferences.

education may be affecting social perceptions in Indigenous communities, and how indigenous cultural forms may interact with this Western exposure. We think this is an exciting direction for future research.

Finally, a comparison of Fijian to Canadian children further suggests less dualistic inference with more exposure to Western cultural influences. Overall, our Fijian participants were more likely to make dualist inferences than Westerners.[6] We manipulated two agency cues in our Fijian sample – the presence of eyes and the presence of self-propelled motion. It is possible that eyes as cue to agency are less important for Fijian social perceivers than our Canadian sample. In collectivistic, hierarchical cultures in Asia (esp. Japan), eye gaze is also used less to determine facial emotional expressions (Yuki, Maddux, & Masuda, 2007) and leads people to use direct eye contact less when answering questions (McCarthy, Lee, Itakura, & Muir, 2016). Direct eye contact is also traditionally avoided in iTaukei Fijian culture, as it is considered more a sign of impudence than confidence or interest in connecting with others (Basow, 1981) – which further supports the notion that exposure to Western culture increases reliance on eye cues in the Fijian context. At a cognitive level, additional research into the specific cues that lead to agency detection and other social inferences in non-Western, traditional, communal contexts are another interesting avenue for future research.

Though our results suggest early developing dualist inference, they do not rule out learning or growing up in societies rich with dualistic conceptions. These results do, however, favor theories which claim that thinking about gods, ghosts, zombies, and the afterlife is cognitively appealing

---

[6] It is tempting to conclude that dualist inferences are a baseline of human reasoning, and that the very recent shift to scientific thinking, buttressed by formal schooling, is actually pushing reasoning away from our dualist roots. However, since we only studied two populations, our data do not permit this conclusion. It is equally plausible that there is something peculiar about Fijian culture that facilitates more dualist thinking—e.g., ancestor gods, spirits and witchcraft concerns are a regular part of village life.

because dualist intuitions emerge reliably and early. Frequently thinking about such cultural products may further enhance dualistic thinking.

We relied on the assumption that when people are asked to point to someone by name and they point to a new body, they are identifying *the agent*. Different theories might construe this as a mind, a soul, an agency, and identity, a homunculus, etc. We remain agnostic, since our data do not allow us to discriminate between these possibilities. However, the different pointing rates across our conditions, and their sensitivity to agency cues, suggest that our participant's point was an attempt to track agency independent of body.

Since this is a new tool for studying dualistic inferences, one might also worry that our results are peculiar to our animations. Perhaps the dualistic inferences shown by our participants were confined to the use of animations, and not associated with broader dualistic intuitions. This is an important concern, but it is mitigated by the fact that both Fijians (children and adults) and Canadian children revealed the same pattern of effects. Fijians had little experience with animations while Canadian children were quite familiar with them. Nevertheless, future work should look for links between dualistic interpretations in our task and broader tendencies toward dualistic interpretations.

Another concern is that participants may not have interpreted our abstract stimuli as a mental agent switching into a new physical body, but shapes as vehicles being driven by tiny people. Perhaps they interpreted 'Penny' to mean 'the most salient shape,' rather than as a proper noun referring to a specific agent. We are confident that our conclusions are robust to such concerns for three reasons. First, anecdotally, some children in Vancouver voluntarily made exclamations like "Penny switched bodies!" Second, even if some people relied on such unconventional interpretations of animated characters or proper nouns, we find it implausible that the most

straightforward interpretation – that animated shapes depict social agents, and that proper nouns are their names – would not have some influence. That is, even if these peculiar interpretations influenced our data, we would expect the patterns predicted by CAD to be ameliorated rather than entirely erased. This was not what we saw. Third, the patterns of variability we observed in response to agency cues speak against many of these interpretations. The transfer of eye-shapes (a well-known agency cue), but not the transfer of another arbitrary shape (a bowtie), greatly increased rates of identifying the triangle as Penny. Participants also pointed to the triangle more often when the pentagon had approached it rather than moved away from it, even though the timing and motion of the triangle was identical in both cases. This makes sense if the motion-towards made it seem that Penny was trying to get into the triangular body. It is harder to explain if participant's choices were merely driven by the visual salience of the triangle.

Our data demonstrate developmental and cross-cultural consistency in dualistic inferences about ambiguous stimuli. This experimental and developmental contribution adds to an emerging corpus suggesting widespread mind-body dualism—tendency to track, reason, and think about minds and bodies as separate/ separable (see also: Cohen et al., 2011; Slingerland & Chudek, 2011). Where previous work relies more on specific cultures' concepts and words map to the English 'mind' (Wierzbicka, 2006), our method depends minimally on language. We relied on consistent use proper nouns—names—to refer to the same individual. Given the non-dualistic nature of minds and bodies shown by modern science, the presence of such reliably-developing dualistic intuitions may create a kind of cognitive susceptibility to certain kinds of cultural beliefs or representations, such as those related to ancestor gods, ghosts, zombies and various notions of the afterlife. This, then, contributes to establishing one of the many cognitive foundations of religion (Boyer, 2001; McCauley & Lawson, 2002; Norenzayan et al., 2015).

References

Ahn, W.-K., Proctor, C. C., & Flanagan, E. H. (2009). Mental Health Clinicians' Beliefs About the Biological, Psychological, and Environmental Bases of Mental Disorders. *Cognitive Science*, *33*(2), 147–182. http://doi.org/10.1111/j.1551-6709.2009.01008.x

Astuti, R., & Harris, P. (2008). Understanding Mortality and the Life of the Ancestors in Rural Madagascar. *Cognitive Science*, *32*(4), 713–740. http://doi.org/10.1080/03640210802066907

Atran, S., & Norenzayan, A. (2004). Religion's evolutionary landscape: Counterintuition, commitment, compassion, communion. *Behavioral and Brain Sciences*, *27*(6), 713–770.

Barrett, H. C., Bolyanatz, A., Crittenden, A. N., Fessler, D. M. T., Fitzpatrick, S., Gurven, M., et al. (2016). Small-scale Societies Exhibit Fundamental Variation in the Role of Intentions in Moral Judgment. *Pnas*, *113*(17), 4688–4693. http://doi.org/10.1073/pnas.1522070113

Barrett, H. C., Broesch, T., Scott, R. M., He, Z., Baillargeon, R., Di Wu, et al. (2013). Early false-belief understanding in traditional non-Western societies. *Proceedings: Biological Sciences*, *280*(1755), 1–6. http://doi.org/10.2307/23353353?ref=no-x-route:b7979c19dd7877929795e4aa940d02e0

Basow, S. A. (1981). Cross-Cultural Patterns in Achievement Motivation - Ethnic Group and Sex Comparisons in Fiji. Presented at the Annual Meeting of the Eastern Psychological Association, New York.

Beier, J. S., & Spelke, E. S. (2012). Infants' developing understanding of social gaze. *Child Development*, *83*(2), 486–496.

Bering, J. M., & Bjorklund, D. F. (2004). The Natural Emergence of Reasoning About the Afterlife as a Developmental Regularity. *Developmental Psychology*, *40*(2), 217–233. http://doi.org/10.1037/0012-1649.40.2.217

Bloom, P. (2004). Descartes' Baby: How the Science of Child Development Explains What Makes Us Human. New York: Basic Books.

Bloom, P. (2007). Religion is natural. *Developmental Science*, *10*(1), 147–151. http://doi.org/10.1111/j.1467-7687.2007.00577.x

Bloom, P., & Weisberg, D. S. (2007). Childhood Origins of Adult Resistance to Science. *Science*, *316*(5827), 996–997. http://doi.org/10.2307/20036275?ref=search-gateway:bfb4ebcb131c2b7284f7901f153fa6a6

Boyer, P. (2001). Religion Explained: The Evolutionary Origins of Religious Thought. New York: Basic Books.

Brison, K. J. (2007). Our Wealth Is Loving Each Other: Self and Society in Fiji. Lanham, MD: Lexington Books.

Callaghan, T., Moll, H., Rakoczy, H., Warneken, F., Liszkowski, U., Behne, T., et al. (2011). Early Social Cognition in Three Cultural Contexts. *Monographs of the Society for Research in Child Development*, *76*(2), i–v– vii– 1–142. http://doi.org/10.2307/41261530

Cohen, E. (2007). The mind possessed: The cognition of spirit possession in an Afro-Brazilian religious tradition. Oxford, UK: Oxford University Press.

Cohen, E., & Barrett, J. L. (2008). When minds migrate: Conceptualizing spirit possession, *8*, 23–48.

Cohen, E., Burdett, E., Knight, N., & Barrett, J. (2011). Cross-Cultural similarities and differences in person-body reasoning: Experimental evidence from the United Kingdom and Brazilian Amazon. *Cognitive Science*, *35*, 1282–1304.

Csibra, G., & Gergely, G. (1998). The teleological origins of mentalistic action explanations: A

developmental hypothesis. *Developmental Science*, *1*(2), 255–259.
Csibra, G., Gergely, G., Bíró, S., Koós, O., & Brockbank, M. (1999). Goal attribution without agency cues: the perception of "pure reason" in infancy. *Cognition*, *72*(3), 237–267. http://doi.org/10.1016/S0010-0277(99)00039-6
Descartes, R. (1985). *The Philosophical Writings of Descartes* (J. Cottingham, R. Stoothoff, & D. Murdoch, Trans.). Cambridge: Cambridge University Press. doi:10.1017/CBO9780511805042
Duranti, A. (2015). The Anthropology of Intentions: Language in a World of Others. Cambridge, UK: Cambridge University Press.
Farroni, T., Csibra, G., Simion, F., & Johnson, M. H. (2002). Eye Contact Detection in Humans from Birth. *Pnas*, *99*(14), 9602–9605. http://doi.org/10.2307/3059245?ref=search-gateway:0cb815ceef6bde8c877b32e6fbd940fd
Gergely, G., & Csibra, G. (2003). Teleological reasoning in infancy: the naïve theory of rational action. *Trends in Cognitive Sciences*, *7*(7), 287–292. http://doi.org/10.1016/S1364-6613(03)00128-1
Gergely, G., Nádasdy, Z., Csibra, G., & Bíró, S. (1995). Taking the intentional stance at 12 months of age. *Cognition*, *56*(2), 165–193.
Gray, K., Young, L., & Waytz, A. (2012). Mind Perception Is the Essence of Morality. *Psychological Inquiry*, *23*(2), 101–124. http://doi.org/10.1080/1047840X.2012.651387
Haidt, J., & Graham, J. (2007). When Morality Opposes Justice: Conservatives Have Moral Intuitions that Liberals may not Recognize. *Social Justice Research*, *20*(1), 98–116. http://doi.org/10.1007/s11211-007-0034-z
Hamlin, J. K., Wynn, K., & Bloom, P. (2007). Social evaluation by preverbal infants. *Nature*, *450*(7169), 557–559. http://doi.org/10.1038/nature06288
Johnson, S. C. (2003). Detecting agents. *Philosophical Transactions of the Royal Society B: Biological Sciences*, *358*(1431), 549–559. http://doi.org/10.1098/rstb.2002.1237
Johnson, S., Slaughter, V., & Carey, S. (1998). Whose gaze will infants follow? The elicitation of gaze-following in 12-month-olds. *Developmental Science*, *1*(2), 233–238. http://doi.org/10.1111/1467-7687.00036
Leslie, A. M. (1994). ToMM, ToBy, and Agency: Core architecture and domain specificity. *Mapping the Mind: Domain Specificity in Cognition and Culture*, 119–148.
Lillard, A. A. (1998). Ethnopsychologies: cultural variations in theories of mind. *Psychological Bulletin*, *123*(1), 3–32.
Low, J., & Perner, J. (2012). Implicit and explicit theory of mind: State of the art. *British Journal of Developmental Psychology*, *30*(1), 1–13. http://doi.org/10.1111/j.2044-835X.2011.02074.x
Luhrmann, T. (2011). Toward an anthropological theory of mind. *Suomen Antropologi: Journal of the Finnish Anthropological Society*, *36*(4).
Luo, Y., & Baillargeon, R. (2005). Can a Self-Propelled Box Have a Goal? *Psychological Science*, *16*(8), 601–608.
Mayer, A., & Trauble, B. (2012). Synchrony in the onset of mental state understanding across cultures? A study among children in Samoa. *International Journal of Behavioral Development*, *37*(1), 21–28. http://doi.org/10.1177/0165025412454030
McCarthy, A., Lee, K., Itakura, S., & Muir, D. W. (2016). Cultural Display Rules Drive Eye Gaze During Thinking. *Journal of Cross-Cultural Psychology*, *37*(6), 717–722. http://doi.org/10.1177/0022022106292079

McCauley, R. N., & Lawson, E. T. (2002). Bringing ritual to mind: Psychological foundations of cultural forms. New York, NY: Cambridge University Press.

McNamara, R. A. (2016, July). *Morality When the Mind is Opaque: Intent vs. Outcome Across the Lifespan in Yasawa, Fiji*. (A. Norenzayan & J. Henrich, Eds.). University of British Columbia, Vancouver.

Nielsen, M., Haun, D., Kärtner, J., & Legare, C. H. (2017). The persistent sampling bias in developmental psychology: A call to action. *Journal of Experimental Child Psychology*, *162*, 31–38. http://doi.org/10.1016/j.jecp.2017.04.017

Nisbett, R. E., Peng, K., Choi, I., & Norenzayan, A. (2001). Culture and systems of thought: holistic versus analytic cognition. *Psychological Review*, *108*(2), 291–310.

Norenzayan, A., Shariff, A. F. A., Gervais, W. M., Willard, A. K., McNamara, R. A., Slingerland, E., & Henrich, J. (2015). The cultural evolution of prosocial religions. *Behavioral and Brain Sciences*, *39*, e1. http://doi.org/10.1017/S0140525X14001356

Notaro, P. C., Gelman, S. A., & Zimmerman, M. A. (2001). Children's Understanding of Psychogenic Bodily Reactions. *Child Development*, *72*(2), 444–459. http://doi.org/10.1111/1467-8624.00289

Phillips, A. T., Wellman, H. M., & Spelke, E. S. (2002). Infants' ability to connect gaze and emotional expression to intentional action. *Cognition*, *85*(1), 53–78.

Premack, D. (1990). The infant's theory of self-propelled objects. *Cognition*, *36*, 1–16.

Schulz, L. E., Bonawitz, E. B., & Griffiths, T. L. (2007). Can being scared cause tummy aches? Naive theories, ambiguous evidence, and preschoolers' causal inferences. *Developmental Psychology*, *43*(5), 1124–1139.

Slingerland, E. (2012). mind-body dualism and the two cultures. In E. Slingerland & M. Collard (Eds.), *Creating Consilience: Integrating the Sciences and the Humanities* (pp. 74–87). New York, NY: Oxford University Press.

Slingerland, E., & Chudek, M. (2011). The Prevalence of Mind-Body Dualism in Early China. *Cognitive Science*, *35*(5), 997–1007. http://doi.org/10.1111/j.1551-6709.2011.01186.x

Wierzbicka, A. (2006). On folk conceptions of mind, agency and morality. *Journal of Cognition and Culture*, *6*(1-2), 165–179.

Woodward, A. L. (2003). Infants' developing understanding of the link between looker and object. *Developmental Science*, *6*(3), 297–311. http://doi.org/10.1111/1467-9280.00218

Yuki, M., Maddux, W. W., & Masuda, T. (2007). Are the windows to the soul the same in the East and West? Cultural differences in using the eyes and mouth as cues to recognize emotions in Japan and the United States. *Journal of Experimental Social Psychology*, *43*(2), 303–311. http://doi.org/10.1016/j.jesp.2006.02.004

Figure Legends

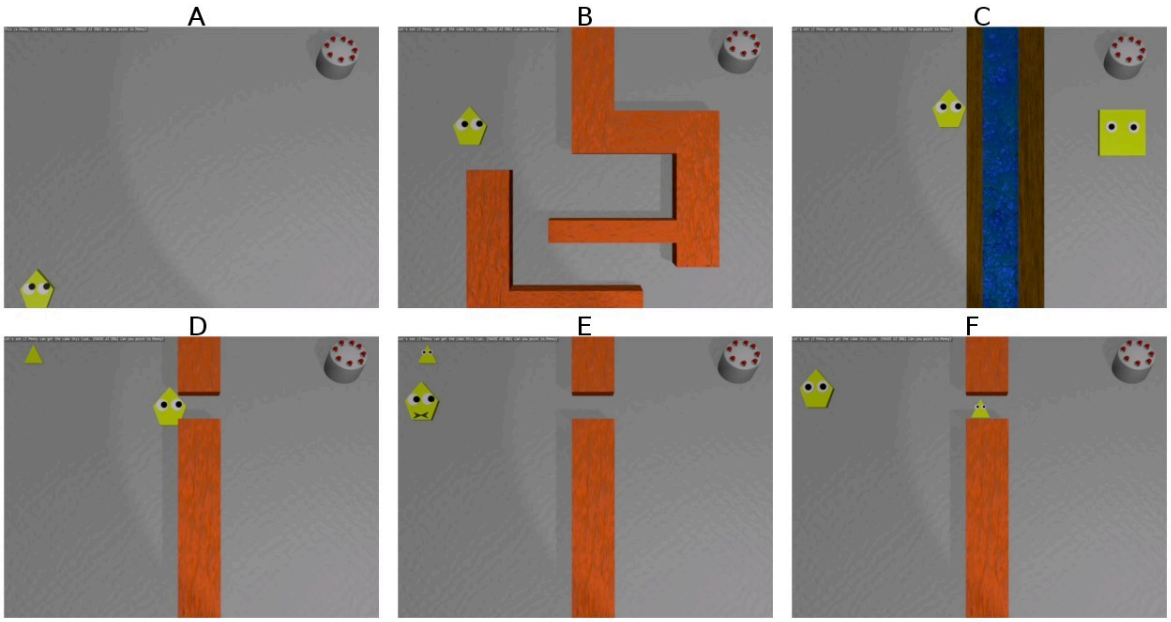

Figure 1. Still images from the videos participants saw: a) First Scenes; b) Maze Scene; c) River Scenes ; d) Testing Scene, Near/Far-Eyes Conditions; e) Testing Scene, Near-Bowtie Condition; f) Testing Scene, Near Condition

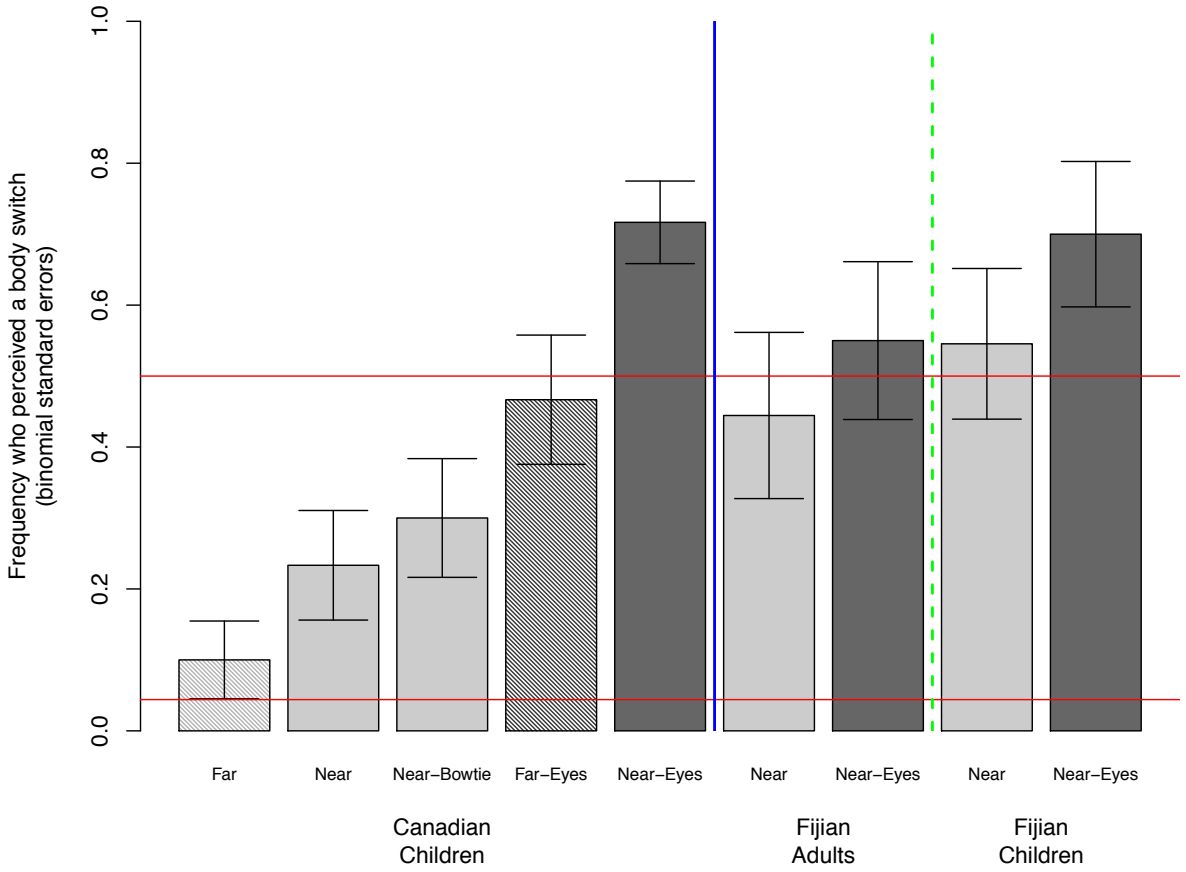

Figure 2. Frequencies of Canadian (left of the solid vertical blue line) and Fijian (right of the same line) adult (left of the dashed vertical green line) and child participants who identified the triangle as Penny in the testing scene, between conditions with 95% confidence intervals. The red horizontal line shows rate at which participants pointed to any non-pentagon location in the unambiguous River Scene (4.4%). For visual clarity, bars representing conditions with eye-cues are shaded a darker color, bars for Far proximity-cue conditions are shaded with oblique lines.

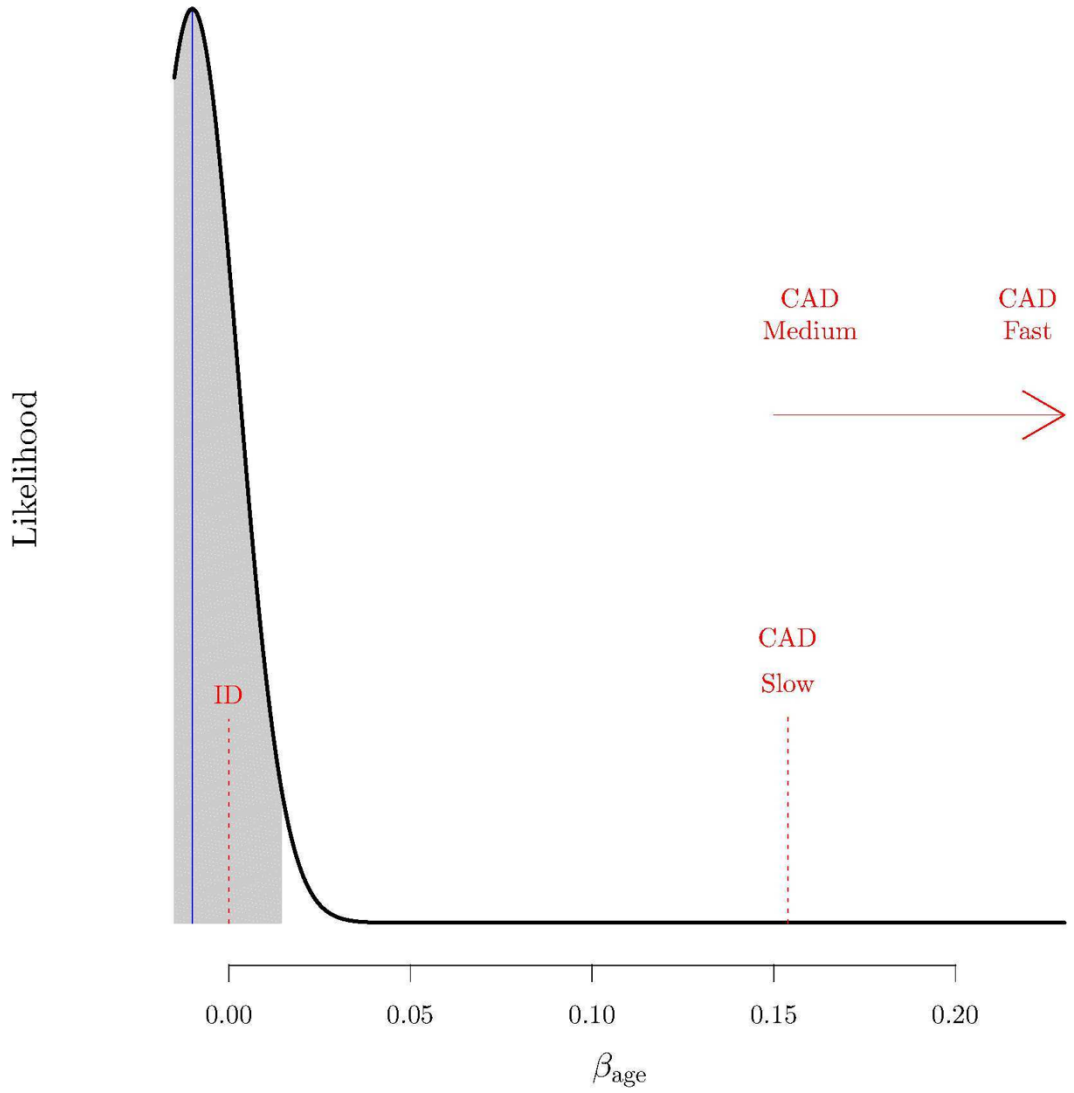

Figure 3. The relative likelihood of our data, given different relationships between participants' age (in years, horizontal axis) and their proclivity to offer dualist interpretations of ambiguous stimuli (formalized as a logistic regression parameter β age). The likelihood maximizing estimate is shown in blue and a grey region shows the 95% confidence interval around it. The predictions made by Intuitive Dualism (ID) and three variants of Culturally Acquired Dualism (CAD) are shown in red.

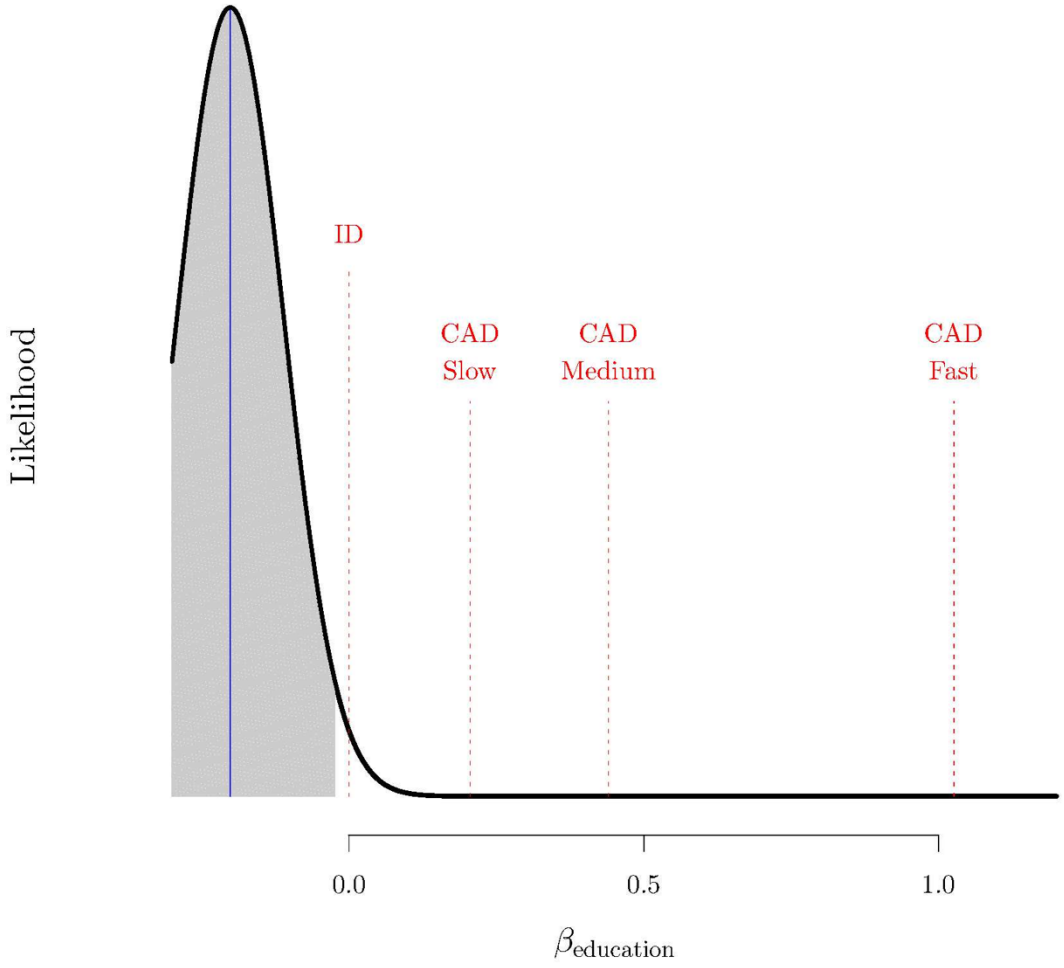

Figure 4. The likelihood of our data, given different relationships between Western-style education among Fijians (in years, horizontal axis) and their proclivity to offer dualist interpretations of ambiguous stimuli (formalized as a logistic regression parameter β education). The likelihood maximizing estimate is shown in blue and a grey region shows the 95% confidence interval around it. The predictions made by Intuitive Dualism (ID) and three variants of Culturally Acquired Dualism (CAD) are shown in red.

Tables

Condition	Cues to Agency	Hypotheses
Near-Eyes	• Eyes disappear on pentagon before eyes appear on triangle • Pentagon moves toward triangle before eyes disappear • Triangle moves after pentagon stops moving	Strongest cues, probable Dualist Inference: Cues to agency (eyes, movement) present in one shape at a time, satisfies possible intuition that switching requires close proximity
Far-Eyes	• Eyes disappear on pentagon before eyes appear on triangle • Pentagon moves away from triangle before eyes disappear • Triangle moves after pentagon stops moving	Weaker cues, possible Dualist Inference: Cues to agency (eyes, movement) present in one shape at a time, does not satisfy possible intuition that switching requires close proximity
Near	• Eyes present on pentagon and triangle for whole video (no eye cues) • Pentagon moves toward triangle before triangle • Triangle moves after pentagon stops moving	Minimal cues, unlikely Dualist Inference: Movement agency cue present in one shape at a time, satisfies possible intuition that switching requires close proximity
Far	• Eyes present on pentagon and triangle for whole video (no eye cues) • Pentagon moves away from triangle before triangle moves • Triangle moves after pentagon stops moving	Minimal cues, unlikely Dualist Inference: Movement agency cue present in one shape at a time, does not satisfy possible intuition that switching requires close proximity
Near-Bowtie	• Eyes present on pentagon and triangle for whole video (no eye cues) • Pentagon has bowtie; bowtie disappears from pentagon, then appears on triangle • Pentagon moves toward triangle before bowtie disappears • Triangle moves after pentagon stops moving	Non-agency Control, unlikely Dualist Inference: Non-agentic cue (bowtie), movement agency cue present in one shape at a time, does not satisfy possible intuition that switching requires close proximity

Table 1 Test Scene conditions with manipulated cues to agency and expected responses if using mind-body dualist inferences.

Condition	Sample Size (% Male)	Age (years) Mean (Std. Dev) [Range]	Triangle-pointing rate Mean (.95 CI)	Binomial test
		Sample: Vancouver, Canada		
Far	30 (40%)	4.4 (1.4) [2,8]	10% (2.62%, 27.68%)	p=0.37
Far-Eyes	30 (36%)	4.9 (1.7) [2.8]	46.66% (28.80%, 65.36%)	p<0.001
Near	30 (63%)	4.7 (1.5) [3,8]	23% (10.64%, 42.70%)	p<0.001
		Sample: Yasawa, Fiji		
Near (Adults)	18 (55%)	44.6 (13.6) [27,79]	44.44% (22.40%, 68.65%)	p<0.001
Near (Children)	22 (45%)	9.6 (2.7) [5,13]	54.55% (32.67%, 74.93%)	p<0.001

**: $p < .01$, *: $p < .05$

Table 2. Sample descriptions and triangle-pointing rates (i.e., dualist interpretations of the ambiguous scene) per condition. The final column is a test against the noise rate: the probability of our data under the binomial hypothesis that in the ambiguous scene, participants were pointing to non-pentagon objects at the same rate as they had in the unambiguous River Scene. Significant results indicate that the pointing to the non-pentagon rate was significantly higher than would be expected based upon the estimated noise rate from the River Scene.

	Vancouver	Fiji		Everyone	Children (2-13 y.o.)		
		Children	Adults		All Conditions	Near Cond.	Near-Eyes Cond.
	OR [.95 CI]	*OR* [.95 CI]	*OR* [.95 CI]	*OR* [.95 CI]	*OR* [.95 CI]	*OR* [.95 CI]	*OR* [.95 CI]
Proximity Cues	2.85** [1.31, 6.42]	--	--	--	--	--	--
Eye Cues	9.26** [4.09, 22.80]	1.86 [0.52, 7.05]	1.61 [0.44, 6.22]	4.54 [2.57, 8.23]	--	--	--
Age	0.87 [0.71, 1.08]	0.87 [0.65, 1.11]	1.04 [0.98, 1.10]	0.99 [0.96, 1.01]	0.95 [0.35, 1.59]	0.73† [0.51, 0.99]	0.96 [0.77, 1.20]
Sex	1.31 [0.61, 2.84]	1.00 [0.27, 3.74]	1.02 [0.26, 3.94]	1.31 [0.75, 2.30]	1.15 [0.67, 1.97]	1.50 [0.42, 5.74]	0.81 [0.31, 2.15]
Population	--	--	--	2.47* [1.13, 5.61]	2.91* [1.11, 8.04]	23.69** [2.92, 344.21]	1.08 [0.26, 4.90]
(Intercept) *β* *(SE)*	-3.28** (0.91)	-0.03 (0.55)	-1.45 (1.08)	-1.36 (0.32)	-0.73 (0.52)	-3.57** (1.32)	0.79 (0.77)
N	150	42	38	230	222	52	80

**: $p < 0.01$, *: $p < 0.05$, †: $p < 0.1$

Table 3. Coefficients and standard errors for logistic regression models used to draw inferences about the effect of age (years, centered), sex (f = 0, m = 1), populations (Fiji= 1, Canada= 0), proximity- and age-cues on rates of pointing to the triangle. The Proximity-Cues predictor is 0 in the Far and Far-eyes conditions, 1 in the Near and Far-Eyes conditions. The Eye-Cues predictor is 0 in the Far and Near conditions, 1 in the Far-Eyes and Near-Eyes conditions.

	Vancouver		Fiji		Everyone	
	Quadratic *OR* [.95 CI]	Exponential *OR* [.95 CI]	Quadratic *OR* [.95 CI]	Exponential *OR* [.95 CI]	Quadratic *OR* [.95 CI]	Exponential *OR* [.95 CI]
Proximity Cues	2.86** [1.31, 6.46]	2.82** [1.30, 6.33]	--	--	--	--
Eye Cues	9.27*** [4.09, 22.83]	9.12*** [4.05, 22.37]	1.78 [0.72, 4.55]	1.70 [0.70, 4.25]	4.89*** [2.74, 9.01]	4.67*** [2.64, 8.56]
Age	0.89 [0.33, 2.31]	--	0.90† [0.80, 1.00]	--	0.89* [0.80, 0.98]	--
Age^2	1.00 [0.91, 1.09]	--	1.00† [1.00, 1.00]	--	1.00* [1.00, 1.00]	--
Log_e (Age)	--	0.54 [0.20, 1.40]	--	0.74 [0.42, 1.28]	--	0.69 [0.42, 1.12]
Sex	1.31 [0.61, 2.84]	1.33 [0.62, 2.88]	1.04 [0.41, 2.64]	1.17 [0.47, 2.91]	1.31 [0.75, 2.30]	1.33 [0.76, 2.34]
Population	--	--	--	--	4.28** [1.68, 11.63]	3.46* [1.37, 9.15]
(Intercept)						
β	-1.83	-1.51†	1.09	0.81	-0.82*	-0.76†
(SE)	(1.29)	(0.82)	(0.72)	(0.89)	(0.37)	(0.45)
N	150	150	80	80	230	230
AIC	175.08	173.06	114.08	115.16	293.71	295.01

***:p <0.001, **: $p < 0.01$, *: $p < 0.05$, †: $p < 0.1$

Table 4. Logistic regression models for quadratic and exponential effects of age; sex (f = 0, m = 1), populations (Fiji= 1, Canada= 0), proximity- and age-cues on rates of pointing to the triangle. The Proximity-Cues predictor is 0 in the Far and Far-eyes conditions, 1 in the Near and Far-Eyes conditions. The Eye-Cues predictor is 0 in the Far and Near conditions, 1 in the Far-Eyes and Near-Eyes conditions.

			Demographics Model		Interactions	
	Quadratic *OR* [.95 CI]	Exponential *OR* [.95 CI]	Full Sample *OR* [.95 CI]	Full Sample *OR* [.95 CI]	Adults *OR* [.95 CI]	Kids *OR* [.95 CI]
Eye Cues	2.56† [0.92, 7.66]	2.58† [0.94, 7.68]	--	0.00† [0.00, 0.26]	0.00† [0.00, 0.26]	3.92 [0.47, 45.28]
Education	0.78† [0.58, 1.01]	0.77* [0.61, 0.95]	0.81* [0.67, 0.97]	0.45† [0.10, 0.87]	0.45† [0.10, 0.87]	0.83 [0.41, 1.64]
Age	1.04 [0.84, 1.27]	--	1.03 [0.99, 1.07]	1.02 [0.95, 1.10]	1.02 [0.95, 1.10]	0.96 [0.65, 1.41]
Age^2	1.00 [1.00, 1.00]	--	--	--	--	--
Log_e (Age)	--	2.10 [0.72, 7.16]	--	--	--	--
Sex	1.38 [0.50, 3.82]	1.43 [0.53, 3.94]	1.37 [0.52, 3.74]	1.27 [0.44, 3.66]	1.04 [0.21, 5.00]	1.46 [0.35, 6.48]
Child	--	--	--	0.01 [0.00, 7.53]	--	--
	β (SE)	*β (SE)*	*β (SE)*	*β (SE)*	*β (SE)*	*β (SE)*
(Intercept)	0.14 (0.90)	-1.14 (1.31)	0.57 (0.47)	5.35 (4.50)	5.40 (4.60)	0.70 (1.82)
Education * Eye Cues	--	--	--	1.15* (0.55)	1.16* (0.56)	-0.20 (0.39)
Education * Child	--	--	--	0.57 (0.56)	--	--
Eye Cues * Child	--	--	--	10.94* (5.11)	--	--
Education * Eye Cues * Child	--	--	--	-1.32† (0.68)	--	--
N	74	74	74	74	36	38
AIC	103.30	101.72	102.56	103.92	50.71	57.03

**: $p < 0.01$, *: $p < 0.05$, †: $p < 0.1$

Table 5. Coefficients and standard errors for logistic regression models used to draw inferences about the interaction between years of education and the effectiveness of eye-cues in the Fijian sample, and in particular its interaction with adulthood. The 'Child' predictor is 1 for Fijians in the child sample (i.e. 5-13 years old) and 0 for participants in the adult sample (i.e. 27-79 years old).

Acknowledgments

Joseph Henrich would like to thank the Canadian Institute for Advanced Research (CIFAR) for their support. Rita McNamara would like to thank the Yasawan villages for their participation in this research. Rita McNamara would also like to thank the Psychology Department of the University of British Columbia in Vancouver, Canada as well as the School of Psychology in Victoria University of Wellington, New Zealand, for their support during preparation of this manuscript. We further wish to thank previous anonymous reviewers for their extensive commentary in helping us improve previous versions of this paper.