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Cultural Variations in the Curse of Knowledge: the Curse of Knowledge Bias in Children from a Nomadic Pastoralist Culture in Kenya

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Abstract

We examined the universality of the curse of knowledge (i.e., the tendency to be biased by one's knowledge when inferring other perspectives) by investigating it in a unique cross-cultural sample; a nomadic Nilo-Saharan pastoralist society in East Africa, the Turkana. Forty Turkana children were asked eight factual questions and asked to predict how widely-known those facts were among their peers. To test the effect of their

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knowledge, we taught children the answers to half of the questions, while the other half were unknown. Based on findings suggesting the bias's universality, we predicted that children would estimate that more of their peers would know the answers to the questions that were taught versus the unknown questions. We also predicted that with age children would become less biased by their knowledge. In contrast, we found that only Turkana males were biased by their knowledge when inferring their peers' perspectives, and the bias did not change with age. We discuss the implications of these findings.

Keywords

social cognition – culture – knowledge attribution – theory of mind – curse of knowledge – hindsight bias

The capacity to reason about other people's mental states, or perspectives, is key for navigating our social world. This capacity allows us to understand one another, and to communicate effectively (Krauss & Fussell, 1991). Importantly, reasoning accurately about other people's perspectives is associated with many positive life outcomes, including: higher academic achievement, more prosocial behaviour, and fewer relationship problems (e.g., Caputi, Lecce, Pagnin, & Banerjee, 2011; Lalonde & Chandler, 1995; Repacholi & Slaughter, 2004; Smith & Rose, 2011). A critical component of reasoning about other people's perspectives is the ability to make accurate inferences about what others know. Unfortunately, this ability is prone to bias – notably, the curse of knowledge bias. The curse of knowledge bias refers to the difficulty associated with ignoring one's own knowledge when reasoning about less-informed perspectives. That is, when someone knows a piece of information, such as the outcome of an event or the answer to a question, he or she tends to overestimate the likelihood that others will also know that information.

Consider, for example, a recent study examining the curse of knowledge on adults' assessment of how widely known information is among peers. Birch et al. (2017) presented participants with a series of factual questions (e.g., "which planet has the longest day?"). Participants were taught the answers to some of these questions a week in advance. That is, participants were presented with the answers to some of the questions and were instructed to memorize them. Participants were not taught the answers to another set of questions. Findings revealed that participants were more likely to overestimate how many of their peers would know the answers to the questions they were taught, compared

to the questions that they were not taught. In other words, having known the answers to the questions, participants overestimated how common that knowledge is among their peers (see also, Fussell & Krauss, 1992, 1992; Nickerson, Baddeley, & Freeman, 1987).

The curse of knowledge has been given different names, including: 'hindsight bias' (Bernstein, Aßfalg, Kumar, & Ackerman, 2016), 'creeping determinism' (see Fischhoff, 1975), the 'knew-it-all-along effect' (e.g., Wood, 1978), 'adult egocentrism' (e.g., Royzman, Cassidy, & Baron, 2003), and 'reality bias' (e.g., Mitchell & Taylor, 1999). All these names refer to the tendency to be biased by one's own knowledge when reasoning about a naïve perspective, or perspectives. This occurs when one is reasoning, in hindsight, about one's *earlier* less-informed perspective, or when one is reasoning about the perspectives of others (e.g., Birch & Bloom, 2003). The curse of knowledge has been studied extensively in various contexts with implications for many different disciplines, including cognitive science, education, economics, politics, medicine, and law (e.g., Harley, 2007; Hinds, 1999; Pinker, 2014).

Researchers have argued that the curse of knowledge is an innate by-product of the human learning system (Henriksen & Kaplan, 2003; Hoffrage, Hertwig, & Gigerenzer, 2000). When we acquire new knowledge our learning system integrates the information into our existing knowledge structures so swiftly and fluently that it becomes difficult to ignore that knowledge and recall our earlier more naïve perspective. Put somewhat differently, it is difficult if not impossible to intentionally unknow something (see Golding, Long, & Macleod, 1994). This learning system serves the critical function of allowing us to keep track of the most recent state of affairs in our constantly changing environments. The downside of this otherwise adaptive learning system is that it is difficult to fully disengage from our current knowledge when we reason about a less-knowledgeable perspective.

In support of the universality of the curse of knowledge, research suggests that children are also biased by their knowledge when reasoning about other perspectives. For example, Taylor, Esbensen, and Bennett (1994) taught North American preschoolers new information (e.g., the colour chartreuse) and asked them how long they have known this information. The researchers found that preschool children were unable to distinguish information that they had known for a long time (e.g., the colour green) versus information they had just learned. That is, upon learning the new information, preschool children were cursed by their new knowledge and believed they had known it all along (see also, Lagattuta et al., 2014; Pohl, Bayen, & Martin, 2010). Bernstein, Erdfelder, Meltzoff, Peria, and Loftus (2011) found that the curse of knowledge follows a U-shaped trajectory across development, such

that the magnitude of the bias is highest in early childhood and late adulthood. Indeed, the finding that younger children show a stronger curse of knowledge bias in their social reasoning compared to older children and adults is corroborated by other research (Birch & Bloom, 2003; Lagattuta et al., 2014; Lagattuta, Sayfan, & Blattman, 2010; Mitchell & Taylor, 1999).

The curse of knowledge is also universal cross-culturally among adults (e.g., Heine & Lehman, 1996; Pohl, Bender, & Lachmann, 2002; Yama et al., 2010). Cross-cultural studies have demonstrated the robustness of the curse of knowledge bias among adult participants from North America, East Asia, Europe, and Australia, though there are mixed results regarding how the magnitude of the bias varies across cultures (see, Choi & Nisbett, 2000; Heine & Lehman, 1996; Pohl et al., 2002; Yama et al., 2010). Notably, the bias has not been studied in children from a non-Western culture. Theoretically, cross-cultural *developmental* research on the curse of knowledge is essential to address whether this bias is truly an innate universal feature of the human mind. By innate, we mean an inherent feature of the mind that does not require specific experience to develop.

Given the myriad of benefits associated with more accurate perspective taking, there is a clear need to better understand the nature of the curse of knowledge bias, its developmental trajectory, and how it manifests cross-culturally. If the curse of knowledge is an innate universal feature of the mind, then we would expect to see evidence of this bias early in development across different cultures and environments. We hypothesized that children would be biased by their knowledge, regardless of their specific cultural upbringing. That is not to suggest that there are no cultural differences in the magnitude of the curse of knowledge. It is possible that certain cultural experiences can attenuate the magnitude of the curse of knowledge in individuals' social reasoning. It is also possible that the developmental trajectory of the curse of knowledge varies depending on children's cultural experiences. For instance, the reported age-related change in the curse of knowledge among Western children (e.g., Birch & Bloom, 2007; Bernstein et al., 2011; Lagattuta et al., 2014) could be a result of Western specific cultural experiences (e.g., Western education system). As a secondary question of interest, we aimed to examine whether the bias follows the same developmental trajectory in a non-Western culture as in Western cultures. Research examining the curse of knowledge among non-Western children can provide support for the view that this bias is universal, even though it cannot directly test whether it is a by-product of an evolutionarily-adapted learning system per se.

Here, we investigated these aforementioned research questions by examining the curse of knowledge bias among Turkana children. The Turkana are

a nomadic Nilo-Saharan pastoralist society in East Africa, who have minimal influence from the Western world (for more information on the Turkana culture see, Mathew, 2017; Mathew & Boyd, 2011). Given that the Turkana are very distinct from the Western Educated Industrialized Rich and Democratic populations (i.e., WEIRD; see Henrich, Heine, & Norenzayan, 2010) that are often targeted for psychological research, examining the curse of knowledge among Turkana children provided a solid test of the universality of the bias. In the following section, we described the Turkana society in greater detail for the reader to get a sense of how different their culture is from previously tested populations.

1 The Turkana

The Turkana are situated in the Turkana county in Northwest Kenya comprised of approximately one million people ("Turkana County – United Nations Joint Programme," 2015). They occupy a semi-arid savanna habitat in northwest Kenya herding cattle, camel, sheep, goat and donkey (see, Mathew & Boyd, 2011). A homestead is comprised of the male household head, his wives, and children, and possibly other relatives living under his care. Turkana settlements are a collection of a few dozen homesteads. Settlements periodically break apart in the dry season as households, especially young adult males of the household, form temporary mobile camps that migrate to access fresh pastures and dry season water wells. Political organization is decentralized, and is built around patrilineal clans groupings, and around age-sets – cohorts of men born within a 5- to 6-year period (Gulliver, 1958). Senior age-sets have authority over junior sets, but no single individual is vested with coercive authority. Post marital residence tends to be patrilocal, and marriage is polygynous.

The Turkana rely on the pastoral sector to make a living with limited market integration. Their subsistence is primarily based on livestock products such as milk, meat and blood, as well as supplies of maize flour, legumes, sugar, and oil that they purchase from town (Little & Leslie, 1998; McCabe, 2004). To purchase such supplies, they sell charcoal that they produce, or they sell one or more stock animals from their herd. Interestingly, in the northern segments of Turkana county, where we conducted the present study, there is a large refugee camp run by the UNHCR. The Turkana sell their stock and purchase supplies from the refugee camp regularly. Accordingly, the presence of the refugee camp has increased the market transactions that Turkana in this area engage in.

The Turkana are a natural fertility population, and most births occur at home. They are only weakly influenced by the Kenyan nation state. Most

Turkana in the pastoral sector have minimal access to medical care as dispensaries are sparse and are located in the town centers. There are no tarmac roads except for one highway that goes through Turkana county into South Sudan. While a handful of Turkana towns have electricity, the vast plains around the towns where most of the pastoral Turkana live do not have electricity. Disputes and violations are typically handled by a gathering of Turkana elders from the area, and there is little reliance on the courts or police of the Kenyan state to maintain order.

The Turkana language is related to the Karimojong language group of Nilo-Saharan languages, and most Turkana who have not been to school do not speak Kiswahili, the national language of Kenya. Christianity began to spread in this region over the last half century, and most Turkana will identify as Christians. There is considerable variation in adherence and practice, with some primarily practicing the local spiritual system, others incorporating both, and a minority adopting Christian beliefs at the exclusion of local spiritual beliefs.

School attendance rates among the pastoralist Turkana is low, but not nil. A typical pattern is for a family to send 1 or 2 of their children to school, and have the majority of the children remain in the pastoral sector as the children are critical for labor. Multiple male children are needed for herding as the different stock animals need to graze in different pastures. Female children are needed to help with household tasks that women do, including fetching water, processing food, building and repairing the huts, charcoal production, taking care of younger siblings, and watering the livestock at the wells. The value of children for herding is the main reason for the low rates of school attendance. Even children who are sent to school are frequently taken back for herding as the needs of the household change. In the area where we conducted the study, there is a primary school 3 km away, but only 17.5% of the children in the sample had completed 1 or 2 years of formal education.

2 Present Study

In the present study, we examined the curse of knowledge bias on Turkana children's estimates of how widely known information is among their peers. Using a design similar to that used with adults (e.g., Birch et al., 2017), we presented children with eight factual questions and taught children the answers to half of the questions. After each question, we asked children to estimate how many of their peers would know the answer (e.g., how many Turkana children, out of ten, will know how many Turkana towns there are?); henceforth, we will refer to their estimates as 'peer estimates'. We predicted

that the Turkana children will make higher peer estimates for questions that they were taught, compared to questions that they were not taught. That is, upon learning the answers to the questions, we predicted that children will show the classic curse of knowledge effect and will overestimate how widely-known the information is among their peers. We also predicted that, like Western children, Turkana children will show a decline in the magnitude of the curse of knowledge with age.

3 Method

3.1 *Participants*

Forty Turkana children belonging to the Ngiyapakuno territorial section of the Turkana were recruited from a northern area of the Turkana County, Kenya (see Figure 1, for an image of the site where the study was conducted). Participants' ages ranged from approximately 2 to 10 years of age (Mean = 5 years, 6 months; SD = 2 years, 3 months). The Turkana do not usually note their date of birth using the Western calendar. The Turkana calendar names each season (which can span a year or more depending on droughts) and does not always differentiate between children who are one year apart. Therefore, the participants' ages were estimated by consensus judgements of local research assistants based on the appearance and developmental stage of the child as well as by incorporating local knowledge of who is older among two children. All participants were of Turkana descent, and 50% of them were female (see Figure 1).

3.2 *Materials and Design*

Participants were presented with a total of eight factual questions (See Table 1). The eight questions were divided into two sets of four (henceforth Set A vs. Set B) that were roughly matched based on content (e.g., both Set A and Set B contained a question on technology and a question about human biology), as well as question difficulty. Half of the children were taught the answers to Set A questions in the Teaching Phase of the experiment (e.g., 'How many bones are in the body?'; Question Set A), and half of the children were taught the answers to Set B questions in the Teaching Phase (e.g., 'How old is the oldest person alive?'; Question Set B). The questions were presented in a predetermined computer randomized order for each participant, for both the Teaching and Peer Estimates Phases.

The questions and the written script used by the researchers during the experiment were first created in English, then transcribed by a local research

FIGURE 1 An image of the site where we examined the curse of knowledge among Turkana children.

assistant to the Turkana language, and finally back-transcribed to English to ensure the intended meaning remained intact in the translation process. Ten small paper tokens with stick figures drawn on them were presented to participants to assist the children in providing their answers.

3.3 *Procedure*

A local researcher administered the experiment with each child individually in a quiet location in their Turkana village in the child's native Turkana language.

TABLE 1 Mean peer estimates for factual questions that were known (taught) vs. unknown

Set	Factual question	Mean peer estimates for known items	Mean peer estimates for unknown items
	How many Turkana towns are there?	4	2.71
A	How do you make candy?	3.58	2.19
	How long does a snake live?	5.16	2.81
	How many bones are in the body?	3.63	2.67
	Set A Average	**4.09**	**2.60**
	How do we make oil/petrol for cars?	2.67	3.32
	How many babies does an elephant have?	3.29	2
B	How old is the oldest person alive?	3	4.89
	What is the most northern Turkana town?	3.95	4.26
	Set B Average	**3.23**	**3.62**

Note. We compared children's peer estimates for the Known items in Set A with the Unknown items in Set B, and vice versa.

Because the experiment involved asking the children to estimate how many of their peers would know the answers to different factual questions (e.g., how many Turkana children, out of ten, will know how long snakes live?), the researcher first administered a short pre-test to gauge the child's numerical and verbal abilities. In this pre-test, the researcher held up eight paper tokens and asked the child how many tokens he or she was holding. If the child responded correctly, then he or she was allowed to provide verbal answers to the later questions, otherwise the child was asked to use paper tokens to indicate his or her answers non-verbally. The researcher then administered three training trials demonstrating how to use the tokens to make a peer estimate. One training trial demonstrated how to use the tokens if they thought it was true of all of their peers. For example, the researcher asked, "how many children can sit?" Then, the researcher demonstrated that since all children can sit they would choose all ten of the ten paper tokens. Two additional training trials were used to demonstrate how to use the tokens to indicate a small number of peers and how to use the tokens to indicate a medium number of peers.

In the Teaching Phase, the researcher taught the child one set of facts (e.g., the answers for Set A questions) in an engaging manner through an animated discussion. Subsequently, in the Peer Estimate Phase, the researcher presented

the child with all eight factual questions. After each question, the researcher asked the child to estimate how many out of ten peers would know the answer. Depending on the child's success on the pre-test (see above), he or she either indicated the peer estimates using paper tokens or responded verbally. At the end of the study session, each child was thanked for his or her participation and rewarded with a piece of candy.

4 Results

A series of multilevel regression analyses were conducted using the lme4 package (Bates, Sarkar, Bates, & Matrix, 2007) in the R environment (R core development team, 2016) to examine whether age, gender, or Gender × Age moderated the curse of knowledge bias. For all analyses, participants' peer estimates, nested within each participant, were entered as the dependent variables. Maximum likelihood was used for estimation. Intercepts were random.

To examine the effect of the curse of knowledge on peer estimates, we coded peer estimates for factual questions that were taught as known (= .5), and we coded the peer estimates for the factual questions that were not taught as unknown (= –.5). We began our analyses by examining whether gender had any effect on the curse of knowledge bias. To test this, we compared a full model, which included known versus unknown items, gender (male = –.5, female = .5), and Known versus Unknown × Gender, with a reduced model without the interaction term. Results suggested that the full model provided better fit compared to the reduced model, $\chi^2(1) = 12.52$, $p < .001$. In the full model, the intercept, that is, the overall mean number of estimates was 3.38 peers, $\beta = 3.38$, $SE = .28$, $t(39) = 12.17$, $p < .001$. There was a main effect of the curse of knowledge, that is, peer estimates were higher by .50 for known versus unknown items, $\beta = .50$, $SE = .21$, $t(39) = 2.35$, $p = .024$ (See Table 1, for an overview of mean peer estimates for each factual question presented by condition). Participant gender did not significantly predict peer estimates in general, $\beta = -.59$, $SE = .55$, $t(39) = -1.07$, $p = .29$. However, there was a significant moderation of the curse of knowledge by gender, $\beta = 1.60$, $SE = .43$, $t(39) = 3.73$, $p < .001$ (see Figure 2, for a visual illustration). That is, females did not exhibit a curse of knowledge bias in their peer estimates whereas males were cursed by their knowledge.

Next, we examined whether age moderated the curse of knowledge effect on peer estimates. A full model, which included known versus unknown items, centred age, and Known versus Unknown × Age, was compared to a reduced model without the interaction term. The full model was not significantly

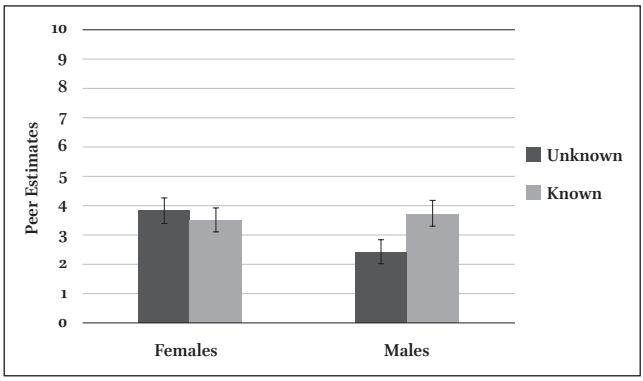

FIGURE 2 Mean peer estimates by condition (known vs. unknown items) and gender (male vs. female).
NOTE. ERROR BARS INDICATE THE STANDARD ERROR OF THE MEANS FOR PEER ESTIMATES.

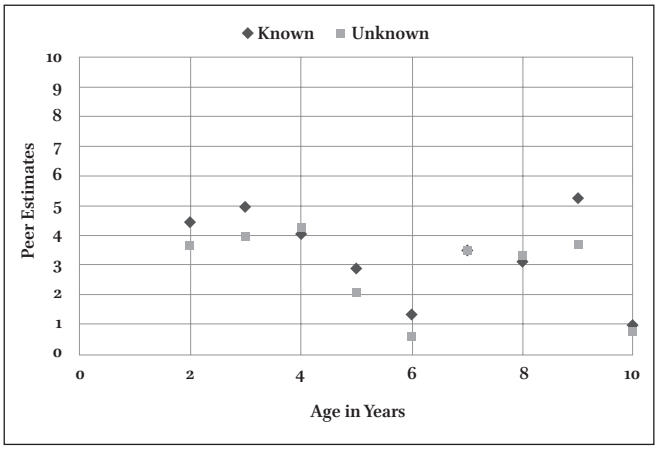

FIGURE 3 Mean peer estimates by condition (known vs. unknown facts) and age (2–10 years).
NOTE, THE NUMBERS OF CHILDREN FOR EACH AGE GROUP ARE NOT EQUAL.

different from the reduced model, $\chi^2(1) = 0.30$, $p = .59$, suggesting that age did not moderate the effect of the bias on peer estimates (see Figure 3, for a visual demonstration of peer estimates by age and condition). To further test the main effect of age on peer estimates across conditions in general, a full model, which included known versus unknown items and centred age was compared to a reduced model without centred age. Results were not significant, $\chi^2(1) = 0.80$, $p = .37$, suggesting that age did not predict peer estimates.

Lastly, we examined whether gender moderated the effect of age on the curse of knowledge. We reasoned that age might only predict the curse of knowledge among males, given that only males showed the bias. Accordingly, we tested whether Gender × Age moderated the effect of the curse of knowledge on peer estimates. A full model, which included known versus unknown, gender, centred age, and all two- and three-way interactions between the variables, was compared to a reduced model without the three-way interaction term and was also not significant, $\chi^2(1) = .44$, $p = .51$, suggesting that Gender × Age did not moderate the bias on peer estimates. All data, code, and documentation is available to the reader upon request to the corresponding author.

Post-hoc power analyses were conducted on non-significant effects following guidelines provided by Hox, Moerbeek, and Schoot (2010, pp. 239–240). For each analysis, there was greater than .85 power to detect a medium effect (i.e., explaining .1 of the between-participant variance) in our sample if such an effect existed.

5 Discussion

The current experiment provides the first evidence of the curse of knowledge bias in a non-Western population of children, specifically the Turkana people of Kenya, Africa. In our experiment, we asked Turkana children to estimate how many of their peers (i.e., other Turkana children) would know the answers to various factual questions. Critically, we had taught children the answers to half of the questions moments before we asked them to make peer estimates. Overall, we found that the Turkana children were biased by their newfound knowledge when reasoning about what their peers were likely to know. That is, they were significantly more likely to estimate that their peers would know the answers to the questions they had just learned, compared to the questions they themselves did not know (a bias sometimes referred to as 'the-knew-it-all-along effect' or 'hindsight bias'; Bernstein et al., 2011; Wood, 1978).

The Turkana represent a population that is considerably different from a WEIRD population (Henrich et al., 2010). As described earlier, the Turkana are minimally integrated to the market. They are a pastoral nomadic tribe who have no, or very minimal access, to media and minimal Western influence. Furthermore, the Turkana have very limited formal education. Evidence of the curse of knowledge bias in this sample adds great weight to previous claims that this bias is a universal and innate cognitive bias in human reasoning

(e.g., Henriksen & Kaplan, 2003; Pohl et al., 2002), perhaps a by-product of an otherwise adaptive human learning process as some suggest (see Hoffrage et al., 2000). However, that does not mean that the bias is unaffected by environmental and cultural factors. Quite the contrary; it appears that environmental and cultural factors play a significant role in the magnitude of the bias, its developmental trajectory, and in how the bias manifests in various sociocultural interactions. Notably, findings from the Turkana sample revealed two important differences from previous findings with Western children. First, we found a significant gender difference, whereby only the males (50% of the sample) exhibited a significant curse of knowledge bias when reasoning about the knowledge of their peers. Second, there was no evidence of a developmental decline in the magnitude of the curse of knowledge bias.

What do these cultural differences tell us? First, we will discuss the gender difference in the curse of knowledge bias. We did not expect that the Turkana females would not show an effect of the bias in their social judgements, given that gender differences had not previously been reported in research on the curse of knowledge bias. Nonetheless, a gender difference whereby females are more accurate than males at reasoning about the mental states of others is consistent with a body of work using *other* mental state reasoning, or social perspective taking, tasks (e.g., Baron-Cohen, 2002; Baron-Cohen, Knickmeyer, & Belmonte, 2005; Baron-Cohen & Wheelwright, 2004). Accordingly, the tendency for the female Turkana children not to be biased by their own knowledge may be a part of a more general cross-cultural pattern where females are somewhat better at social reasoning on average than males.

We suspect, however, that cultural differences in the division of labor for Turkana males versus females accounts for at least some of the gender difference observed in the curse of knowledge bias among the Turkana children. Turkana females tend to spend more time within their communities interacting with other individuals compared to Turkana males. For example, Turkana females are often responsible for taking care of their younger siblings. On the other hand, from early on, males tend to be involved in more solitary tasks such as herding animals. This gender difference in their social interactions may afford females more opportunities than males to learn about the knowledge states of others providing input that would assist them in overcoming the curse of knowledge bias. Note, for instance, that while Turkana females take care of their younger siblings, they may be routinely recognizing, and reasoning about, their siblings' more naïve perspectives. That is, they may have more practice overcoming the curse of knowledge to take the perspectives of their younger siblings.

It is also possible that what is gained by the Turkana females in their cultural interactions is not necessarily social skills per se but *other* cognitive skills, such as improved inhibitory control or greater source memory, both of which are believed to play a role in overcoming the curse of knowledge bias in Western children (e.g. Birch & Bernstein, 2007; Gopnik & Graf, 1988; Taylor et al, 1994). For example, it could be that the Turkana females were better at recognizing *the source* of their knowledge (i.e., that they had just learned the answers themselves), and could think more critically about the likelihood that others would share that knowledge (Gopnik & Graf, 1988; Jacoby, Kelley, Brown, & Jasechko, 1989). Research examining gender differences in inhibitory control, source memory, critical thinking, and other social perspective taking tasks in Turkana children would be fruitful avenues for future research.

In addition, future research would benefit from examining the conditions under which Turkana females *are* susceptible to the curse of knowledge bias. If the bias is truly a universal aspect of human cognition as the evidence suggests, then one would expect everyone to exhibit the bias under certain conditions. For example, we suspect that lengthening the time period between teaching the children the facts and asking them to make their peer estimates would result in a greater curse of knowledge bias, one even the girls may have difficulty overcoming. The longer the information is known, the more entrenched and fluent that information becomes, and the harder it is to recall the source of one's knowledge and recognize the privileged nature of that information (e.g., Birch et al., 2017).

What do the cultural differences in *the developmental trajectory* of the curse of knowledge bias tell us? In contrast to Western populations, we found that the oldest Turkana males were just as biased as the youngest males. First, we needed to rule out the possibility that the lack of an age effect stems from inadequate statistical power to detect an age difference in our sample. The current study had approximately .91 power to detect a medium effect size of age on the curse of knowledge bias, if an age effect existed. We suspected a medium effect size of age on the curse of knowledge bias, because previous research reported a medium to large effect size (e.g., Birch & Bloom, 2003; Lagattuta et al., 2014). Therefore, the finding that age does not moderate the curse of knowledge among Turkana children cannot simply be attributed to lack of power in our current design.

One possible explanation for this cultural difference is that the curse of knowledge bias decreases at an earlier age among Western children because of differences in their formal education compared to Turkana children. For instance, according to the National Center for Education statistics in 2015,

around 90% of American children enrolled in kindergarten by 5 years of age. Comparatively, only 17.5% of children in the current Turkana sample completed 1 or 2 years of formal education. Formal education could contribute to a decrease in the curse of knowledge bias in any number of ways, such as through increases in critical thinking, inhibitory control, or source memory, or by greater opportunities for peer interactions to name a few. It is also possible that other environmental differences between the two cultures (e.g., differences in informal education, family and sibling interactions, language, etc.) contribute to these cultural differences in the curse of knowledge bias. Pinpointing the causal agents for these cultural differences will be important avenues for future research now that these cultural differences in the curse of knowledge bias have been established.

It is important to acknowledge, however, that there is more than one way to interpret developmental data across cultures. The above explanations are working on the assumption that the curse of knowledge bias *decreases at an earlier age* among Western children. However, because these particular test questions (e.g., How many Turkana towns are there?) could not be used with a Western sample, it is difficult to say with certainty how the developmental trajectory of the curse of knowledge compares across the two cultures. It is possible that even the *youngest* Turkana children exhibit a curse of knowledge bias similar in magnitude to older Western children. That is, without a Western comparison group using the same test questions we cannot rule out the interesting possibility that Turkana children are *less cursed earlier in development* than Western children. It is also important to remind the reader that children's ages in the current sample were estimated, as the Turkana do not use the Western calendar to note birth dates. Accordingly, the finding that age did not moderate the bias in this sample should be interpreted with some caution. Future research would benefit from a replication of this study using test questions that would be appropriate for both Turkana children and Western children.

5.1 *Summary*

In sum, the current experiment examined the curse of knowledge bias in the Turkana people of Kenya, Africa. As far as we know, this is the first experiment to examine, and find, the curse of knowledge bias in children from a Non-Western sample, lending the critically-needed developmental support to previous arguments that this bias is a universal, innate, feature of human cognition. Interestingly, we found two important cultural differences in the bias in the Turkana children compared to Western children, demonstrating the key role that culture plays in the manifestation of this bias. First, only male Turkana

children were significantly biased by their knowledge when gauging what their peers would know. Second, unlike Western children there was no developmental decline in the magnitude of the bias with age. That is, the oldest Turkana children, specifically males, were equally as biased by their knowledge when reasoning about the knowledge of their peers as the youngest children in the sample. Although not without limitations (as noted above), these data offer new insights into the origin and cognitive mechanisms involved in social perspective taking and provide the impetus and groundwork for much-needed future research in this area.

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Author Contributions

SB and MC designed the experiment. MC collected the data with research assistants and resources provided by SM. SG and KF analyzed the data. SG took the lead in writing the manuscript under the supervision of SB and input from all authors. Resources were provided by SB and SM.