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Journal

Proceedings of the Annual Meeting of the Cognitive Science Society, 48(0)

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Publication Date

2026

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Peer reviewed

Children's reasoning, visual attention, and social cognition in Mexico and the US

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Abstract

Cross-cultural variation in cognition is increasingly well-documented, but less research has explored the developmental origins of this variation. In addition, Central and South American cultures are underrepresented in research with both adults and children, but particularly the latter. This study helps to fill this empirical gap by comparing Mexican and U.S. preschoolers (34–62 months; Mexico N=153; U.S. N=125) across six tasks spanning relational and similarity reasoning (causal Relational Match-To-Sample, Taxonomic-Thematic Triads), visual attention (Picture Free Description; Feature Task), and social cognition (Uniqueness Preference; Symbolic Self-Inflation). We find cross-cultural differences in four of the six tasks, with Mexican children showing greater contextual and relational sensitivity than U.S. children on several measures. In contrast, cRMTS and feature-based recognition do not show reliable country differences, underscoring that cultural contrasts depend on the specific task and developmental process being measured.

Keywords: cognitive development; causal learning; relational reasoning; language; culture; context; Latin America; Mexico

Introduction

The ways people attend to, group, and interpret relations among objects, events, and people vary systematically across cultures (Nisbett et al., 2001; Masuda, 2017). In adult samples, these differences are often described in terms of two prototypical cognitive styles: an analytic style, in which attention is primarily directed towards salient focal objects and their attributes, and a holistic style, in which attention extends to relationships among objects, agents, and contexts (Masuda, 2017; Masuda et al., 2019; Masuda & Nisbett, 2001). These contrasts have been documented across a wide range of domains, including visual attention (Chua et al., 2005; Ji et al., 2000), categorization (Ji et al., 2004), social reasoning (Spencer-Rodgers, Boucher, Mori, et al., 2009), and causal attribution (Morris & Peng, 2004), and have played a central role in theories of cultural variation in cognition (e.g., Markus & Kitayama, 1991; Nisbett et al., 2001).

Despite the breadth of the adult literature, far less is known about when and how such cultural differences emerge in development (Nielsen et al., 2017). Existing developmental evidence suggests that cross-cultural variation does not emerge uniformly across cognitive domains. Some paradigms show reliable cultural differences as early as 3–4 years of age, particularly when they require attention to either focal objects or

contextual relations (e.g., visual search, relational matching; Kuwabara & Smith, 2016, Carstensen et al., 2019). In contrast, other paradigms (e.g., picture description, eye tracking, framed-line test) do not show consistent differences until later in childhood, after around 6 years of age (Duffy et al., 2009; Imada et al., 2013; Köster et al., 2018; Senzaki et al., 2016; Senzaki & Shimizu, 2022). This underscores the importance of a developmental approach: cultural differences must be understood as emerging and developing within domain-specific developmental trajectories, rather than treated as static group-level contrasts.

A second limitation of existing work is its relatively narrow cultural scope. Most cross-cultural research on cognition has focused on comparisons between Western and East Asian populations, a pattern that has been critiqued for limiting theoretical generalizability (Kitayama, 2022). Latin American cultures (in Mexico, Central and South America, and the Caribbean), in particular, remain underrepresented in both adult (Henrich et al., 2010; Arnett, 2016) and developmental (Nielsen et al., 2017) work, despite their potential to challenge or refine prevailing models of cultural psychology. The limited adult literature from Latin America suggests that populations in the region may follow distinct patterns that are not well captured by a simple Western–Eastern contrast (De Oliveira & Nisbett, 2017). Importantly, the goal of the present study is not to place Mexican cognition along a pre-existing East Asian–Western continuum, but to examine whether developmental patterns identified in prior cross-cultural work generalize to an understudied cultural context with its own social, linguistic, and historical structure. For instance, Latin American adults resemble European American samples in valuing uniqueness, self-interest (Krys et al., 2022; Vignoles et al., 2016), and positive self-views (Senft et al., 2021, Salvador, 2023; Salvador et al., 2025), yet recent work argues that more positive self-views, usually associated with individualism, may be grounded in more collectivist, relational goals such as warmth, harmony, and social connection in Latin American contexts (Salvador et al., 2025). Research on visual attention and similarity reasoning in Latin American contexts is also sparse and mixed: some studies report cognitive profiles resembling those of typical Western samples (Kardan et al., 2017), whereas others suggest stronger relational or contextual sensitivity, particularly in certain ecologies or subpopulations (De Oliveira & Nisbett, 2017; Mavridis et al., 2020). Importantly, little is known about how these patterns

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appear in early childhood, when cognitive and social systems are still being organized.

Relational reasoning, the ability to abstract higher-order relations beyond surface features, provides a useful developmental anchor for investigating these questions. This capacity has long been recognized as a core component of human learning, supporting generalization, categorization, and causal inference (Gentner, 1988; 2003; Gentner & Rattermann, 1991). Classic accounts describe a “relational shift,” in which children move from object-based to relation-based processing over the course of childhood. However, recent findings suggest that the timing and form of this shift may vary across cultural contexts. Using the causal Relational Match-To-Sample (cRMTS) task (Walker & Gopnik, 2014), Carstensen and colleagues (2019) found that U.S. children show a U-shaped developmental trajectory between 18–48 months, with a temporary decline in preschool, whereas Chinese children show stable success over the same window. Subsequent work with South Korean preschoolers revealed yet another pattern, intermediate to the U.S. and Chinese trajectories (Carstensen et al., 2023). These findings indicate that the preschool years may represent a period of reorganization in how children weigh object-based versus relational information, and that this reorganization unfolds differently across cultural contexts.

Importantly, however, cRMTS performance is only one window into children’s relational processing. A wide range of cognitive and social processes have been proposed to support or constrain relational reasoning. These include how children allocate visual attention between focal objects and background context (Imada et al., 2013; Kuwabara & Smith, 2016), how they weigh categorical and thematic similarity (Ji et al., 2004; De Oliveira & Nisbett, 2017), and how they conceptualize the self in relation to others (Kim & Markus, 1999). Notably, although these domains are related to relational reasoning, they are not assumed to reflect a single underlying construct. Rather, they are theorized to shape how readily children notice, represent, and use relational structure. Despite this, performance on these tasks is rarely measured together within the same group of children, particularly during early childhood and across multiple cultural contexts. As a result, it remains unclear which dimensions of early cognition already differ across cultures, which do not, and how these differences may relate to the development of relational reasoning during a developmental window when many cognitive systems are in flux.

The Present Study

In the present work, we take a descriptive, developmental mapping approach to early cross-cultural variation in cognition. We compare preschoolers from the United States and Mexico across six tasks spanning relational reasoning (cRMTS), visual attention (Free Description, Imada et al., 2013; Features Task, Kuwabara & Smith, 2016), similarity reasoning (Taxonomic–Thematic Similarity, Ji et al., 2004), and social orientation (Uniqueness Preference, Kim & Markus, 1999;

Symbolic Self-Inflation, Kitayama et al., 2009). This design allows us to address three related questions.

First, we characterize relational reasoning in Mexican preschoolers using the cRMTS task. As discussed above, this paradigm has been used to study early relational abstraction, but has not yet been applied in a Latin American sample. Second, we document whether and when cross-cultural differences between U.S. and Mexican preschoolers emerge across multiple theoretically relevant domains. Because each of these domains is expected to have its own developmental trajectory, measuring them together within a narrow age range provides a snapshot of how cultural variation is patterned at a point when relational, attentional, and social-cognitive systems are undergoing rapid change. Third, we explore which, if any, of these domains covary within and across cultures, in order to identify which dimensions of early cognition are most closely aligned with children’s relational reasoning during this window.

Given that the present data are correlational, we treat this study as a mapping exercise: by documenting which cognitive and social dimensions already differ across cultures in early childhood, and how these dimensions pattern together within individuals, we aim to constrain future mechanistic accounts and inform the design of additional experimental work. By situating relational reasoning within a broader profile of visual, conceptual, and social processing, and by extending this approach to an underrepresented cultural context, the present study seeks to broaden the empirical foundation of cross-cultural developmental science. Importantly, rather than asking whether one culture is “more relational” or “more analytic” in a global sense, we ask how different aspects of cognition are already differentiated across cultures in the preschool years, and how these differences align with one another.

Methods

Participants

Our planned sample size was 304, with 152 in each context, a sample large enough to detect small-to medium-sized effects, and to double the sample of prior work conducted with similar measures (i.e., Carstensen et al., 2019, Experiment 1). The Mexican sample is complete and includes 153 children, all native Spanish speakers (70 male, 70 female, 13 gender undisclosed). U.S. data collection is nearing completion, with a current sample of 125 children (65 male, 60 female), all native English speakers. ¹Mexican participants were recruited from Tijuana ($n = 94$), Tampico ($n = 46$), and Monterrey ($n = 13$), and U.S. participants were recruited from San Diego, California. In both countries, families were recruited through local preschools and museums. In the U.S., additional participants were recruited through a university-affiliated laboratory. Because many Mexican participants were recruited through

¹Because Mexican participants were recruited from three sites, all primary models were also run with recruitment site as a fixed-effect covariate. The pattern of results was unchanged, suggesting that the reported effects were not driven by site-level differences.

preschools using IRB-approved director consent procedures, detailed family demographic data were not collected consistently beyond age, gender, language background, and recruitment site. All children were tested in their native language by a native speaker (most of the experimenters were bilingual native speakers of Spanish and English, who tested children in both populations). Importantly, the present study does not assume homogeneous or isolated national cultures. Border regions are themselves meaningful sociocultural contexts, and the current samples should be interpreted as reflecting cognition within these particular contexts, rather than as national groups.

The U.S. sample ranged from 34–62 months ($M = 46.7$, $SD = 8.15$) and the Mexican sample ranged from 34–61 months ($M = 47.2$, $SD = 6.96$). We excluded participants from analyses of individual tasks if they were missing more than 25% of the data from that task, failed to follow instructions, or showed a side bias (choosing the left or right option on all trials of the relational reasoning or triads task), resulting in no more than 17 exclusions per task in Mexico and 7 per task in the U.S.

Procedure

Participants completed six tasks assessing relational reasoning (cRMTS), similarity reasoning (Taxonomic-Thematic Triads), social cognition (Uniqueness Preference, Symbolic Self-Inflation), and visual attention (Picture Free Description, Features Task). The session lasted about 15 minutes per child and was completed in a single sitting. Tasks were presented by the experimenter in a fixed order: cRMTS, Picture Free Description, Taxonomic-Thematic Triads, Uniqueness Preference, Symbolic Self-Inflation, and Features Task. Children received a small toy for participating.

Causal Relational Match-to-Sample (cRMTS) Task materials and procedures followed those of Walker & Gopnik (2014). Children watched as the experimenter placed pairs of blocks on a box that played music with some pairs but not others. For children in the same-pair condition, the box played music only when matching blocks were placed on top, and the child had to infer this same rule and use it to choose between pairs of novel blocks to make the box play music. In the different condition, mismatched blocks were causal and children likewise had to choose a novel mismatched pair to succeed. After four training trials, the experimenter presented the novel matched and mismatched pairs and asked the child to choose the ones that would make the box play music. The experimenter recorded the child's first point or reach and scored the response as correct if the child chose the pair whose relation (same or different) matched the causal relation demonstrated during training.

Picture Free Description. Following Imada et al. (2013), we measured attention to visual context using spontaneous descriptions of images in a memory task. Participants viewed seven images, each with a salient focal object (e.g., an animal or vehicle) and a naturalistic background (e.g., buildings, fo-

liage, terrain). Each image was shown for 15 seconds, after which participants were asked to describe what they had seen. The experimenter used up to three prompts to elicit additional description (e.g., "Anything else?", "Is that all?"), with the trial ending after the third prompt or when the participant said they had no more to add. Descriptions were coded for: (1) whether the first element mentioned was focal (the central object or agent) or part of the background, and (2) the total number of references to the focus and background (with, for example, "black cat" counted as two references to the focus). Because the scenes were static images containing common focal and background elements, first mention was treated conservatively as an index of salience in spontaneous description rather than as a pure attentional measure, since linguistic and narrative conventions may also contribute.

Features Task. The Features Task, from Kuwabara and Smith (2016), assessed children's ability to recognize objects from diagnostic local features presented without the full object context (e.g., an occluded dog with only part of its ear, paw, and tail showing). Stimuli were photographs from six target categories (airplane, dog, chair, duck, car, hat), with two unique instances per category (12 feature test trials total). Each image was occluded by a black box so that only three spatially separated, highly diagnostic parts were visible. On each trial, a page with six occluded stimuli was presented, and children were asked to point to the target image (e.g., "Look, there's a car. Where is the car?"), with no feedback provided. To ensure children understood the procedure, the study started with one Whole Picture trial with no occluders, and children were given feedback on incorrect points; three more of these trials were interspersed within the test trials. Trials were administered in a fixed order, with accuracy recorded on each trial.

Taxonomic-Thematic Similarity. This task assessed children's preference for grouping items by taxonomic similarity (shared category membership) versus thematic similarity (association or shared context). We used a subset of 15 test triads adapted from Ji and colleagues (2004), preceded by four practice trials (with unambiguous correct answers) to ensure children understood the procedure. Each trial displayed a cue image and two candidate match images, and children were asked to select the option that was most closely related to the cue. On test trials, one match was taxonomically related to the cue (e.g., monkey–elephant), and the other was thematically related to the cue (e.g., monkey–banana), yielding a two-alternative forced choice between a taxonomic and a thematic match on every trial. Test triads were administered in a fixed order, with practice trials always presented first. Children indicated their choice by pointing, and no feedback was provided during test trials.

Uniqueness Preference. The Uniqueness Preference task assessed children's preference for harmony versus uniqueness (Kim & Markus, 1999). Children were shown five pens that

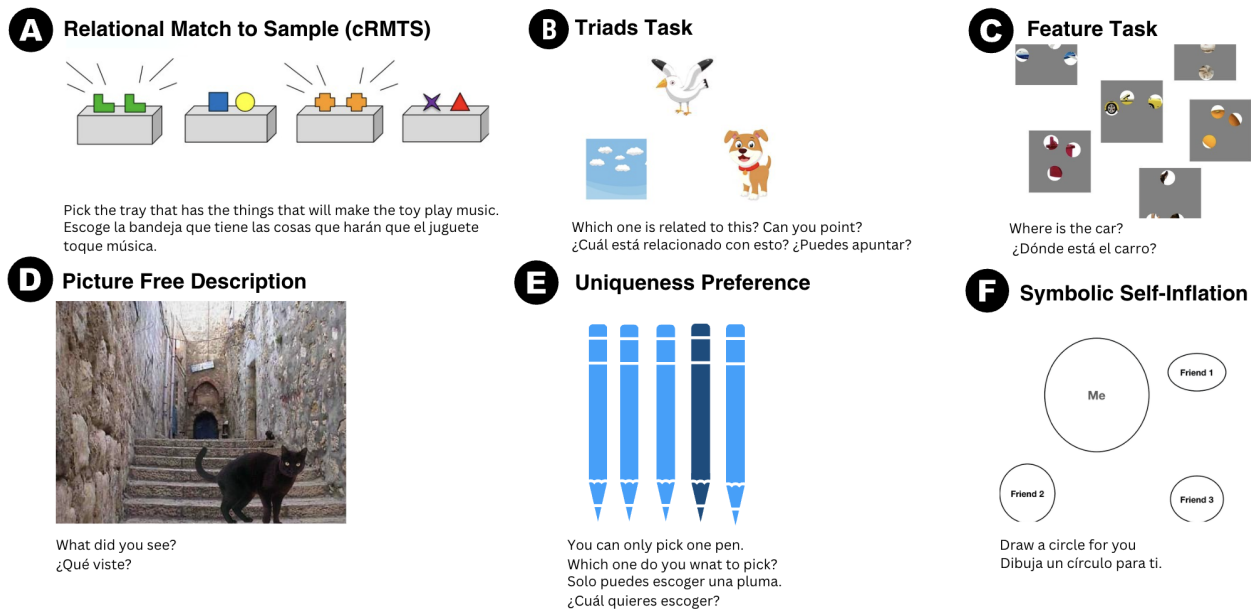


Figure 1: Overview of the tasks assessing relational reasoning (A), similarity reasoning (B), visual attention (C–D), and social cognition (E–F).

were identical except for color, with four pens in one shade and one pen in another (dark vs. light blue); which shade was unique was randomized across participants. The experimenter invited the child to choose their preferred pen, children responded by pointing, and the selection was recorded as unique or not.

Symbolic Self-Inflation. We used a Symbolic Self-Inflation task adapted from Kitayama and colleagues (2009) to measure participants’ self-concepts in relation to their social network. Participants were given a blank sheet of paper and asked to draw a circle to represent themselves and circles to represent three friends. If a participant did not name any friends, the experimenter prompted them to name a sibling or classmate (e.g., “Do you have any brothers or sisters? Is your brother your friend?”). The experimenter recorded the corresponding person’s name for each circle. We measured the horizontal diameter of each circle and computed Symbolic Self-Inflation as the ratio of the self-circle diameter to the mean diameter of the other circles.

Results

Causal Relational Match-to-Sample. To examine developmental and cross-cultural differences in cRMTS performance, we ran a logistic regression predicting children’s relational performance with country (US or Mexico), age (in months and scaled), training condition (same or different), and their interactions as fixed effects. Performance estimates were similar across countries at age 3 (U.S.: $M = 0.54$; Mexico: $M = 0.53$), but diverged by age 4 (U.S.: $M = .60$, $SE = .07$, $p < .05$; Mexico: $M = .80$, $SE = .05$, $\beta \approx 0.83$, $p < .001$). Training conditions (same vs. different) did not reliably pre-

dict performance (U.S.: same $M = .60$ vs. different $M = .55$; Mexico: same $M = .68$ vs. different $M = .64$). Taken together, the model-implied means indicate a general improvement in relational reasoning from ages 3 to 4 in both samples, with a numerically larger improvement in Mexico (Figure 2).

Picture Free Description. Based on prior work showing cross-cultural differences in picture memory (Imada et al., 2013), we examined whether children differed in (1) whether they mentioned focal or background elements first, and (2) whether they described more focal or background information.

For first mention, we fit a mixed-effects logistic regression predicting whether the first mentioned element was focal (vs. background), with country, age, and their interaction as fixed effects and random intercepts for participant and scene, as well as a by-scene random slope for country. There was an effect of country in the predicted direction: U.S. children were more likely than Mexican children to mention focal elements first (U.S. $M = 0.94$; Mexico $M = 0.85$), $\beta = -1.07$, $SE = 0.34$, $z = -3.11$, $p < .01$. There was no reliable effect of age or country by age interaction.

For full descriptions, we analyzed descriptor counts with a mixed-effects Poisson regression predicting the number of descriptors, with description type (focal vs. background), country, and their interaction as fixed effects and random effects for participant and scene. There was a robust main effect of description type, with more focal than background descriptors overall ($\beta = 0.92$, $SE = 0.13$, $z = 7.33$, $p < .001$).

Descriptor totals were similar across countries for both types, indicating no reliable country difference in the focal–background balance.

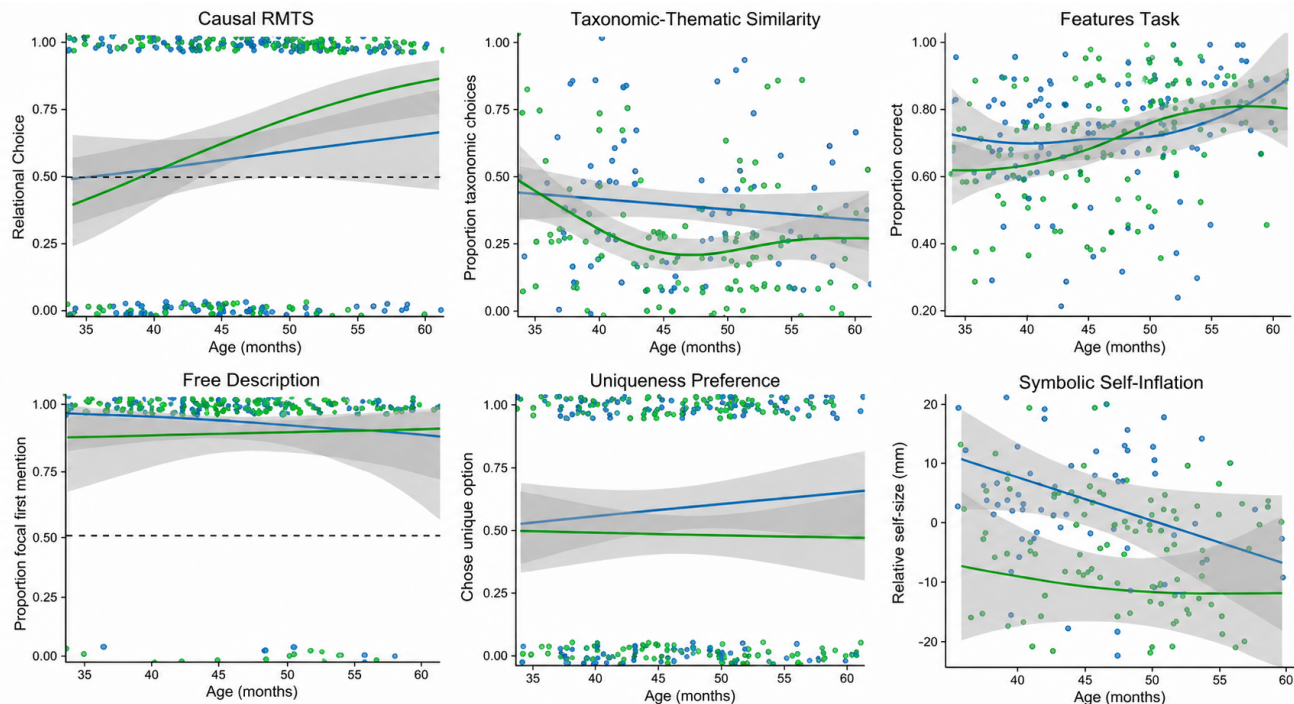


Figure 2: Mexico (green) and U.S. (blue). Dots show individual children and panels include logistic fits (95% CI).

Features Task. To test whether feature-based object recognition differed across Mexico and the United States, we fit a mixed-effects logistic regression predicting trial-level accuracy from country, age, and their interaction with random intercepts for subject and trial. Performance was nearly identical across countries. Accuracy increased with age, $\beta = 0.37$, $SE = 0.09$, $z = 4.36$, $p < .001$, but with no other effects observed.

Taxonomic-Thematic Similarity. We analyzed triad matching performance using a mixed-effects logistic regression predicting whether children selected a taxonomic versus thematic match from country, age, and their interaction as fixed effects, with random intercepts for participant and triad item. Consistent with prior work (De Oliveira & Nisbett, 2017), children in the United States were more likely to select taxonomic matches than children in Mexico (proportion taxonomic matches: U.S., $M = 0.37$, $SD = 0.25$; Mexico, $M = 0.26$, $SD = 0.21$). Country was a reliable predictor of response ($\beta = -0.67$, $SE = 0.17$, $z = -3.96$, $p < .001$), and there was no evidence for a country by age interaction.

Uniqueness Preference. We examined cross-cultural preferences for uniqueness by using logistic regression to predict each child's single choice (unique vs. non-unique option) from country, age, and their interaction as fixed effects. U.S. children were more likely than Mexican children to choose the unique option (U.S., $M = 0.62$, $SD = 0.49$; Mexico, $M = 0.47$, $SD = 0.50$; $\beta = -0.63$, $SE = 0.25$, $z = -2.55$, $p = .011$). The country by age interaction was not significant. This pat-

tern contrasts with prior work showing that adults in Mexico and other Latin American contexts often prioritize uniqueness over harmony (Krys et al., 2022; Vignoles et al., 2016).

Symbolic Self-Inflation. Symbolic Self-Inflation was operationalized as a self-friend difference score (self-circle diameter minus the mean friend-circle diameter). We tested for a country difference using a linear regression predicting this difference score from country, age, and their interaction. U.S. children showed greater symbolic self-inflation than Mexican children (U.S.: $M = 3.56$, $SD = 20.1$; Mexico: $M = -5.7$, $SD = 24.2$; $\beta = 0.23$, $SE = 0.07$, $t = 3.29$, $p < .001$). Age and the country by age interaction were not significant. These results contrast with prior work showing that adults in Mexico and other Latin American contexts often report relatively strong endorsement of individual distinctiveness and positive self-views (Krys et al., 2022; Vignoles et al., 2016; Senft et al., 2021).

Relations Between Individual Tasks and RMTS. Across tasks, we tested whether children's performance on visual attention, similarity reasoning, and social orientation correlated with cRMTS accuracy, and whether these associations differed by country. Because some task scores were missing (primarily due to task-specific exclusions and incomplete responses), we conducted listwise-complete analyses. The task with the most missing or excluded data had 17 exclusions in Mexico and 7 in the U.S., with fewer exclusions for all other tasks.

Overall, associations between cRMTS accuracy and the

other measures were modest, suggesting that the set of tasks does not strongly cohere in this dataset. The largest associations with cRMTS (by absolute value) were Symbolic Self-Inflation ($r = -0.32$), Picture Free Description background-share ($r = 0.19$), and Taxonomic-Thematic Similarity ($r = 0.12$). In contrast, correlations with Picture Free Description focal-first ($r = -0.04$) and Uniqueness Preference ($r = -0.08$) were near zero. Symbolic Self-Inflation showed the clearest association with cRMTS: children who rated themselves as larger relative to peers tended to show lower cRMTS accuracy ($r = -0.32$, $p < .05$). No other association reached significance.

Discussion

The present study offers a snapshot of early cross-cultural variation in cognition by comparing Mexican and U.S. preschoolers across six tasks spanning relational reasoning, visual attention, similarity reasoning, and social cognition. This design allows us to consider how multiple theoretically relevant domains of cognition are patterned across cultures of interest during a period of rapid developmental change. Three key findings emerge.

First, Mexican and U.S. preschoolers differed across most cognitive domains. Mexican children showed more context-sensitive picture descriptions, greater thematic grouping in similarity judgments, weaker uniqueness preference, and lower self-inflation than U.S. peers. These findings suggest that culturally patterned differences in attention, categorization, and self-construal are already present by preschool age. However, the differences were not uniform: cRMTS showed an age-related pattern in both countries, numerically larger in Mexico, while feature-based object recognition did not show a cross-cultural difference.

Second, most findings mirror patterns observed in Mexican and European American adults. In similarity reasoning, Mexican preschoolers showed a greater tendency toward thematic responding, a pattern that parallels findings reported in Latin American adults (de Oliveira & Nisbett, 2017). In visual attention, Mexican preschoolers were more likely to mention contextual information first in the picture description task. To our knowledge, this constitutes the first evidence from an urban Latin American sample using this paradigm in either the developmental or adult literature. However, this pattern is consistent with findings from other interdependent cultural contexts (e.g., Imada et al., 2013). On both social orientation tasks, Mexican children treated the self as less distinctive and more closely aligned with others than their U.S. peers, again consistent with an interdependent or collectivist self-view. At the same time, these patterns contrast with adult findings showing relatively strong endorsement of positive self-views (Salvador et al., 2023; Salvador et al., 2025) and uniqueness (Senft et al., 2021) in Latin American populations. Yet, as noted in the Introduction, recent accounts suggest that these views may be rooted in relational goals (Salvador et al., 2025). From this perspective, the present data may re-

fect an early-emerging form of relational self-orientation that later supports culturally distinctive expressions of these values in adulthood. Although additional work is needed to trace how these early patterns change over the course of childhood, these data highlight how developmental evidence can refine and contextualize adult findings.

Third, associations across tasks were generally weak, suggesting that these measures do not reflect a single coherent dimension of relational cognition. Although Symbolic Self-Inflation showed the largest association with cRMTS performance, this initial finding should be interpreted cautiously. The current results suggest that children who represented the self as more inflated relative to close others were less likely to select the relational match. In contrast, measures of visual attention, similarity reasoning, and preference for uniqueness showed little or no association with cRMTS performance in this sample. Of course, it is possible that these processes play a role over longer developmental timescales, or via pathways that are not captured by the current tasks.

Several limitations should be noted. First, detailed demographic information was unavailable, particularly in the Mexican sample, which constrained our ability to isolate regional, linguistic, socioeconomic, or migration-related factors. Second, because all tasks were administered in the same sequence, potential carryover or fatigue effects cannot be ruled out. Finally, although bilingual exposure was assessed, inclusion was based on reported first language: Spanish in Mexico and English in the U.S. Future work should examine how bilingual exposure may shape performance.

Although the current design does not support causal claims, this pattern serves a more modest, but theoretically useful role: it helps to prioritize which dimensions of early cognition are most promising for future investigation. For example, based on these findings, future work should examine how social orientation relates to relational reasoning across tasks, age, and learning contexts, and whether it moderates the effects of linguistic or attentional experience. Taken together, the present findings suggest that early cultural variation in cognition may be better characterized as a partially dissociable profile of attentional, conceptual, and social tendencies, rather than as a unitary cognitive style.

Finally, the present study also contributes to the growing recognition that Latin American populations cannot be treated as intermediates between Western and East Asian cultures. Even in childhood, Mexican children exhibited a task profile that only partially overlaps with patterns previously reported in East Asian and North American samples, suggesting that cultural variation may not be well captured by a single dimension. This work, therefore, helps to broaden the empirical foundation on which theories of cultural cognition are built and underscores the value of expanding developmental research to include understudied populations.

Acknowledgments

We would like to thank the Early Learning and Cognition Lab at UC San Diego for their guidance and support, and El Trompo Museo Interactivo in Tijuana for their support with recruitment. We are also grateful to the many research assistants who supported this project through data collection and coordination, including Andrea Ortiz, Carmen Orendain, Sara Gara Gonzalez, and Vanessa Alvarez. This study was funded by the Jacobs Foundation and an NSF CAREER award (SBE 2047581) to C.M. Walker.

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