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SHORT REPORT

Developmental differences in children and adults' enforcement of explore versus exploit search strategies in the United States and Turkey

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Abstract

Across development, as children acquire a deeper understanding of their environment, they explore less and take advantage, or "exploit," what they already know. Here, we test whether children also enforce exploration-oriented search behaviors onto others. Specifically, we ask whether children are more likely to encourage a search agent to explore versus exploit their environment, and whether this pattern varies across childhood (between 3 and 6 years). We also ask whether this pattern differs between children and adults, and generalizes across two different sociocultural contexts—Turkey and the United States—that differ on dimensions that might relate to children's decisions about exploration (e.g., curiosity-focused educational practices, attitudes toward uncertainty avoidance). Participants (N = 358) watched an agent search for rewards and were asked at various points whether the agent should "stay" (exploit) in their current location, or "go" (explore) to a new location. At all points in the experiment, children enforced exploration significantly more often than adults. Early in the agent's search, children in the US enforced exploration more often than children in Turkey; later in the search, younger children (from both sociocultural contexts) were more likely to continue enforcing exploration compared to older children. These findings highlight that children are not only highly exploratory themselves, but also enforce exploration onto others—underscoring the central role that exploration plays in driving early cognitive development across diverse sociocultural contexts.

KEYWORDS
cognitive development, cross-cultural, decision making, exploration, explore-exploit trade-offs

Research Highlights

- The current study examined developmental and cross-cultural differences in children and adults' enforcement of explore-exploit search strategies.
- Children in the US and Turkey enforced exploration more than adults, who enforced exploitation more often; results were generally consistent across cultures with small differences.
- Mirroring developmental changes in children's own search behavior; the tendency to enforce exploration decreased between 3- to 6-years of age.

- Findings underscore the central role of an "exploration mindset" in children's early decision-making—even when exploration has no direct benefits to the child themselves.

1 | INTRODUCTION

Exploration is a defining characteristic of early childhood. When given the choice to explore something new, or exploit something known, children generally opt to explore, whereas adults tend to exploit (Blanco & Sloutsky, 2020; Liquin & Gopnik, 2022; Schulz et al., 2019). Balancing these decisions (i.e., resolving the explore-explore dilemma) is notoriously challenging. On the one hand, exploitation can be a "strategic" choice in decision-making: once it is clear that a resource pays off, exploitation helps maximize rewards and minimize the costs associated with exploration (e.g., time and effort). Though costly, exploration is necessary to learn about an environment and enable more effective future decision-making. Across development, as children acquire increased knowledge about their world, they tend to explore less and exploit more (Blanco & Sloutsky, 2021; Nussenbaum et al., 2023). Children's tendency to explore early in development is often regarded as a key driver of learning because it allows them to learn broadly about their environment and its underlying structure (Gopnik, 2020).

The increased frequency of exploratory behaviors in early development is seen across the animal kingdom. Comparative studies on a range of species—including rodents (Moriceau & Sullivan, 2006), parrots and corvids (O'Hara & Auersperg, 2017), hyenas (Benson-Amram & Holekamp, 2012), and nonhuman primates (Perry et al., 2017)—has shown that relative to older members of these species, younger individuals tend to be less neophobic and more exploratory. Just like in humans, these exploratory behaviors have been argued to be foundational for later learning (Pellegrini et al., 2007). For example, during their fledgling period (i.e., the time between birth and being able to fly), New Caledonian crows explore the affordances of objects they will use as tools in later development (Holzhaider et al., 2010). Together, this work highlights that an early tendency to explore is a critical developmental milestone that sets the stage for later learning.

Though it is clear that exploration is central to early development, and that children generally favor exploration in their own behavior, it is an open question whether children explicitly monitor others' decisions to explore versus exploit, and hold expectations about how they should navigate this trade-off. Testing children's reactions to others' explore-exploit decisions—rather than measuring their own behavior—will provide new insights into children's beliefs about how the explore-exploit trade-off should be navigated, even when there are no immediate, direct costs or benefits to them.

While past work has repeatedly shown that children are skilled social learners (Gweon, 2021), paying careful attention to and learning from the actions of others, research has yet to directly test whether and how children (or adults) respond to and learn from others' explore-exploit decisions (for a review, see Lloyd et al., 2023). However, research on children's reactions to individuals' decision-making dilemmas in other contexts demonstrates that children are highly attentive to the kinds of decisions others make, and will even intervene in situations when they think a poor decision has been made. For example, Schmidt and Tomasello (2012) showed that when children witness an individual make an unconventional decision (e.g., play a traditional game the "wrong" way), they will spontaneously and explicitly enforce the conventional behavior (e.g., the "right" way to play the game). Though these findings cannot speak to precisely how children might think the explore-exploit trade-off should be navigated, they do highlight that children pay close attention to decisions made by others—even when those decisions have no direct impact on them, and importantly, raises the possibility that children may *also* attend to and hold beliefs about decision-making in other domains, such as how to navigate the explore-exploit trade-off, even when there is no direct benefit to themselves. If young children, relative to adults, enforce exploration, rather than exploitation, onto others—and if this effect is observed in children growing up in diverse sociocultural contexts—it will highlight the centrality of the drive to explore in children's early thinking and development.

In the current study, we examined the enforcement of explore/exploit behaviors in children and adults in the United States and Turkey. These countries were selected because the majority of research on explore-exploit decision-making has come from North America and Western Europe, and including participants from Turkey will enrich and expand our understanding of explore-exploit decision-making. Turkey and the US make a particularly interesting comparison for examining explore-exploit decision-making because of similarities and differences in these sociocultural contexts that might relate to the development of exploration. Comparing the enforcement of explore-exploit behaviors across children and adults in these two cultures will provide new insights into the role of sociocultural factors in shaping how individuals think about the explore-exploit trade-off.

While no research to date has directly compared how children in the US and Turkey navigate the explore-exploit dilemma, a few studies have examined the importance that caregivers in different cultures place on factors that might relate to children's exploration, such as the value caregivers place on children's curiosity. Since exploration is a key aspect of curiosity, examining child-rearing values surrounding curiosity may provide insights into socialization practices shaping children's exploration, and adults' attitudes toward exploration. Research conducted separately in the US (Tamis-Lemonda et al., 2002) and Turkey (Ünlütabak et al., 2019) found that caregivers in both countries report that curiosity is an important value to instill in children—suggesting

that adults in both cultures value exploration, and that exploration may be an important feature of both children and adult's behavior across both cultures.

Despite the similarities observed across these two studies, Turkey and the US differ in educational practices related to curiosity, which may reflect differences in adults' attitudes related to exploration, and lead to differences in children's exploration tendencies. One key factor treated differently in educational contexts in Turkey and the US is the value placed on intellectual autonomy (i.e., the independent pursuit of ideas and expression of curiosity; Schwartz, 1999; Schwartz, 2004). Schwartz (1999) found that teachers in Turkey attributed less importance to intellectual autonomy compared to teachers in the US. More recent work has found that curiosity in classrooms continues to receive less emphasis in Turkey compared to the US, and that these differences are observed as early as preschool (Yenen & Ulucan, 2021). Although cross-cultural research on children's own curiosity is limited, these differing values held by teachers might reflect differences in adults' attitudes toward curiosity and exploration, and lead children to express curiosity and exploration differently across cultures.

Though it is difficult to pinpoint the sources of these differences, past work has shown that individuals in the US and Turkey have different approaches to dealing with uncertainty (Hofstede, 2011). Tolerance for uncertainty is a central component of exploration, as exploring new environments or situations requires venturing into the unknown. Differences in uncertainty avoidance (i.e., how much individuals are willing to tolerate the unknown) may contribute to differences in educational practices related to exploration, as well as differences in how individuals navigate the explore-exploit trade-off. Hofstede (2011) found that adults in Turkey tend to score higher on measures of uncertainty avoidance than adults in the US—meaning that, on average, adults in Turkey tend to avoid uncertainty and prioritize future predictability relative to adults in the US. The *uncertainty management framework* holds that one way of minimizing uncertainty is by maximizing present rewards and avoiding risks (Amir & Jordan, 2017; Amir et al., 2018; Amir et al., 2020). Since exploration, compared to exploitation, inherently involves foregoing known rewards and taking risks, this work suggests that both children and adults in the US may be more exploratory than their counterparts in Turkey, and consequently, may also enforce exploration onto others at higher rates.

2 | THE CURRENT STUDY

In the current study, we modified a traditional foraging explore-exploit task (Mehlhorn et al., 2015) to be an observational viewing experience in which participants watched an agent explore and exploit different search environments (fish tanks) for rewards (sea creatures) with variable success. Participants were asked at two points whether the agent should continue searching one environment or move on to search a new environment. We tested both children and adults to examine whether there are developmental differences in patterns of enforcing exploration and exploitation, similar to the patterns observed in individuals' own search behavior. Past work has shown that the shift from exploration to exploitation in children's own search behavior, along with critical changes in the nature and scope of early exploration (e.g., efficiency, complexity), occurs between 3- and 6-years of age (Giron et al., 2023; Gopnik et al., 2017; Murray, 2012; Pelz & Kidd, 2020). Thus, we included a wide range of children in our study (i.e., children between 3- to 6-years of age) to test for developmental differences in children's enforcing behaviors. Consistent with developmental changes in children's own exploration behavior, we hypothesized that children would enforce exploration at rates higher than adults. We also predicted that across early childhood, children would become less likely to enforce exploration, and more likely to enforce exploitation. If the developmental shift in the enforcement of explore/exploit behaviors is observed across diverse sociocultural contexts, and not specific to children growing up in Northern America/Western Europe—where much of the existing research in this area has been conducted—it will further underscore the importance of exploration as a driver of early cognitive development. However, given differences in sociocultural factors that might relate to exploration (e.g., educational practices related to curiosity, attitudes toward uncertainty avoidance), we hypothesized that children and adults from the US might enforce exploration at higher rates than children and adults from Turkey.

We used a forced-choice design, requiring participants to choose between "staying" or "going" for two reasons. First, a forced choice, rather than an open-ended design, allowed us to include a wider age range of children (i.e., 3–6 years) with varying verbal abilities, capturing potential developmental differences within childhood. Second, this forced-choice design enabled us to more effectively capture cross-cultural differences in children's enforcement of stay versus go behaviors, as opposed to cross-cultural differences in willingness to interfere other behaviors, as past work has already shown that cultures differ in the degree to which they will interrupt others' behaviors (e.g., in norm violation tasks; Gampe & Daum, 2018).

Though the experimenter asked participants what the search agent should do, participants had no agency over the agent's behavior because their search sequence was fixed across videos. We chose to use this parasocial (one-sided) design, rather than having participants directly interact with and change the agent's behavior, because it allowed us to standardize the agent's search success and trajectory across all participants and directly compare participants' choices across ages and countries. This design also has high ecological validity in that it is akin to children's everyday parasocial interactions with TV shows and other media platforms in which children are asked one-sided questions from a character, as seen in popular shows like "Dora the Explorer," "Gabby's Dollhouse," "Charlie's Colorform Cities," or "Blue's Clues & You!," and are popular among the target age group in both the US and Turkey (Richards & Calvert, 2017; Ryan, 2010).

The search agent had the option of choosing to search in one of five tanks in a 2 min period, with the passage of time displayed to participants via an hourglass timer. The first prompt came after the agent had searched five times in the first tank, and had experienced consecutive failures (i.e., failed to find sea creatures). The second prompt came after the agent had searched one time in a new tank, and had just experienced success (i.e., successfully found a sea creature).

Given the clear evidence of failure in the first tank, and success in the second tank, we predicted that the majority of participants would enforce exploration (i.e., going to a new tank) at the first prompt, but switch to enforcing exploitation (i.e., staying in the same tank) at the second prompt. Asking participants to choose whether the search agent should "stay" or "go" just after experiencing failure (Prompt 1) or success (Prompt 2) allowed us to pinpoint the degree to which participants prioritize maximizing rewards, versus exploring for the sake of exploration and experiencing new search environments. To test whether participants' responses were robust to subtle variations in the search agent's behaviors, we randomly assigned participants to watch one of two types of videos—in a "depth" video, the agent searched fewer tanks, spending more time in each; in a "breadth" video, the agent searched more tanks, spending less time in each. In both videos, the agent experienced failure immediately preceding Prompt 1, and success immediately preceding Prompt 2.

3 | METHODS

3.1 | Participants

3.1.1 | United States

The child sample included 142 3- to 6-year olds (71 females, 1 nonbinary, M_{age} = 4.90 years, SD_{age} = 0.87, $n_{3\text{-year-olds}}$ = 31, $n_{4\text{-year-olds}}$ = 40, $n_{5\text{-year-olds}}$ = 54, $n_{6\text{-year-olds}}$ = 17). An additional seven participants were tested but excluded due to technological/procedural errors (n = 6) or developmental delays (n = 1). Children were recruited through preschools, social media platforms, and the web platform Children Helping Science. Parents had a 4-year college (40.4%) or graduate degree (46.8%), or high school degree or below (12.8%). Parents identified their child's race as White (58.9%), Asian/Asian American (14.2%), Hispanic/Latin American (13.5%), Native American/American Indian (2.8%), Black/African American (1.4%), Middle Eastern American (0.7%), preferred not to disclose (7.8%) or indicated as not listed (7.8%).[1] Families received a $10 gift card for compensation.

The adult sample included 66 adults (31 females, 1 nonbinary, M_{age} = 24.1 years, SD_{age} = 8.19, Range = 18–68 years). Eighty-nine percent of the adult participants were university students. As compensation, participants were entered in a drawing to receive a $50 gift card.

3.1.2 | Turkey

The child sample included 90 3- to 6-year-old children (49 females, M_{age} = 5.20 years, SD_{age} = 0.71, $n_{3\text{-year-olds}}$ = 2, $n_{4\text{-year-olds}}$ = 30, $n_{5\text{-year-olds}}$ = 42, $n_{6\text{-year-olds}}$ = 16). An additional participant was tested but excluded due to procedural error. Children were recruited through preschools and social media platforms. Parents had a 4-year college (47.7%) or graduate degree (31.8%), or high school degree or below (20.5%). Parents identified their children as Turkish (84.1%), Kurdish (2.3%), Circassian (1.1%), preferred not to disclose (6.8%), and indicated as not listed (5.6%).[2] Families received a participation certificate as compensation.

The adult sample included 60 adults (30 females, M_{age} = 26.1 years, SD_{age} = 11.7, Range = 18–74). Eighty percent of the adult participants were university students and were thanked for their contribution.

3.2 | Procedure

This study was approved by the ethics' committees in the United States and Turkey (IRB Protocol Numbers are STUDY00012799 at Arizona State University in the United States and E-47749665-050.01.04-101 for the child study and E-47749665-050.01.04-1434 for the adult study at MEF University in Turkey). All study materials, data, and analysis code can be found on OSF at the link: https://osf.io/jx7he/

Children's data were collected over Zoom in both countries as part of a larger study investigating children's active learning. Before beginning the study, caregivers provided consent and children provided verbal assent. Children listened to an experimenter read a storybook and then played a 15-min aquarium search game. After completing the game, they participated in a 5-min "Search Enforcement Task," the focus of the present paper. Of the children who participated in this larger study, all but 26 (n_{US} = 9 and n_{Turkey} = 17) participated in the "Search Enforcement Task" (e.g., because they grew tired/disinterested and chose to end the experiment prior to the start of the task). In this task, children watched a video that showed an agent (from the storybook they listened to earlier) playing an abridged version of the game they had played earlier, and were asked to tell the experimenter how the agent should search. Adult participants provided consent and were asked to watch the same search enforcement video with the same instructions as children, though adults had no prior experience with the task or agent. Adults were tested in-person, in a minimally distracting space on a university campus.

3.2.1 | Search enforcement task

The video featured a cartoon agent, "Scuba Sam" (in Turkish, "Dalgıç Deniz"[3]), searching for sea creatures by dipping a net into fish tanks arranged in an aquarium with five possible tanks to search (see Figure 1). Participants were told that Sam had 2 min to find as many sea creatures as possible, and once Sam left a tank to move to a new tank, they could not go back. A 2-min hourglass played to mark how long Sam had to explore the aquarium. When Sam's search attempts were successful, a sea creature emerged for 5 s with a pleasant noise; when searches were unsuccessful, Sam's net shook (2 s), and an unhappy face appeared with an unpleasant noise (3 s).

Participants were randomly assigned to watch one of two video types that varied in the agent's search strategy and sequence of search outcomes (see Figure 1). In the *Depth Exploration* video, Sam searched two of the five tanks, persisted in searching despite consecutive failures, and spent more time in each tank, visiting only two of five tanks

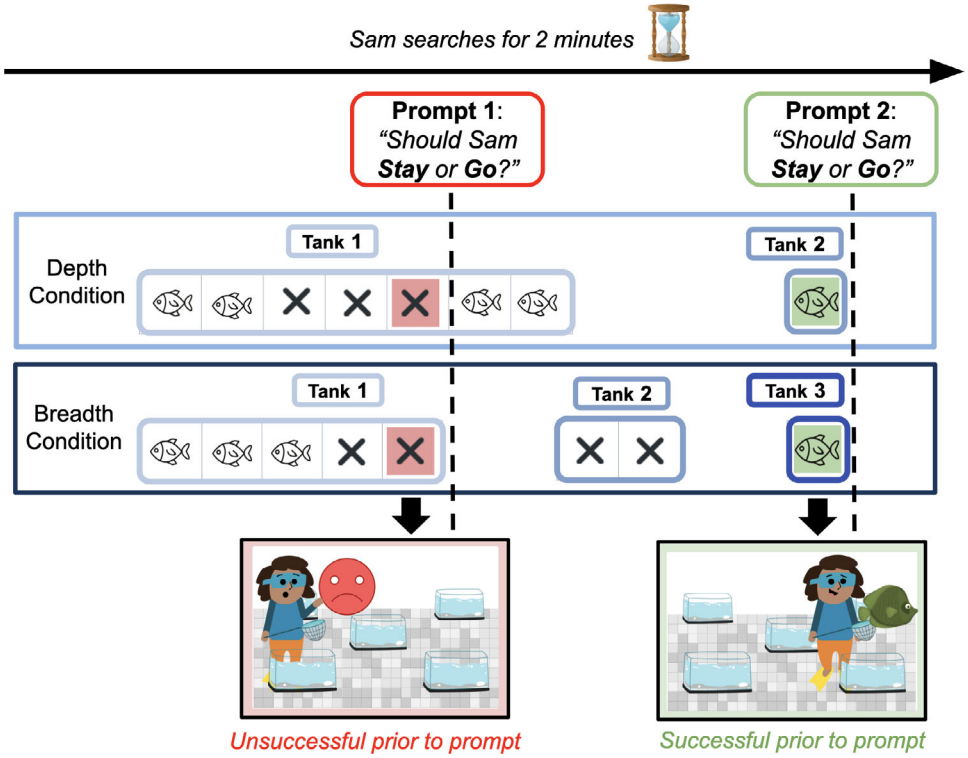

FIGURE 1 Experimental schematic. The sequence of the agent's search behaviors presented to participants. At each search attempt, the agent was either successful (marked by a fish, see bottom right) or unsuccessful (marked by an X, see bottom left). The first prompt ("Prompt 1″) "Should Sam Stay or Go?" occurred after an unsuccessful search; the second prompt ("Prompt 2″) occurred after a successful search. Though only four tanks are shown in the screenshots, participants were given a full view of all five tanks prior to the start of the video, and in between each tank transition. The hourglass timer gave participants a clear, ongoing indicator of how much of the 2 min had passed.

by the second Prompt. In the *Breadth Exploration* video, Sam searched three of the five tanks by the second Prompt, spent less time in each tank, and switched to new tanks after only two consecutive failures. In both videos, the agent searched 14 times and found 7 rewards in total.

The experimenter asked participants at two points in the video: "Should Sam ***stay*** and keep looking in this tank, or ***go*** to a new tank?," once after the 5th search attempt ("Prompt 1") and once after the 8th search attempt ("Prompt 2"). At Prompt 1, Sam had just experienced consecutive misses (two in the Breadth video; three in the Depth video). At Prompt 2, Sam had just arrived at a new tank, and in both videos, experienced one success before the prompt. Though participants were asked what Sam should do, they had no agency over Sam's behavior because the search sequence was fixed across videos (see Figure 1).

The video continued to play (without any additional prompting) after Prompt 2, and Sam made six additional search attempts. This design allowed us to (a) measure spontaneous comments from participants about the agent's search behavior and (b) not abruptly end the video for participants, as it was already brief and pilot testing showed that children enjoyed watching it. We did not analyze the spontaneous comments during this period because they were rarely observed, especially among the less verbal, younger children. The dependent measure was whether participants responded "stay" or "go" in response to each prompt. If children refused to reply, or their response was ambiguous, their data were not included in the analysis ($n = 1$ response at Prompt 1).

To assess reliability of the children's data, independent coders coded a random sample of 40% of participants in Turkey, and 10% of participants in the US, showing that there was no disagreement for children's responses of "stay" or "go" in response to Prompt 1 and 2 ($\kappa = 1.00$ at both prompts).

4 | RESULTS

Across the experiment, participants were significantly more likely to say "go" (60.5% of the time) than "stay" (39.25% of the time; chance = 50%; $t(357) = 6.82$, $p < 0.001$, $d = 0.36$). We tested whether children and adults differed in their overall use of "go" versus "stay." Across the experiment, children enforced "go" significantly more than adults: children said "go" 65.75% of the time, and "stay" 34.05% of the time, whereas adults said "go" 51.2% of the time, and "stay" 48.8% of the time. Children's use of "go" was significantly greater than chance ($t(231) = 8.47$, $p < 0.001$, $d = 0.56$), whereas adults' use of "go" did not differ from chance ($p > 0.05$). A Mann–Whitney U test compared the frequency of the use of "stay" and "go" across age groups and found significant differences between children and adults in the use of both "go" ($U = 11{,}077$, $p < 0.001$) and "stay" ($U = 11{,}024$, $p < 0.001$).

We also tested whether children and adults differed in their use of "go" at the first and second prompt. At both prompts, children said "go" at a higher frequency compared to adults: at Prompt 1, children said "go" 92.2% of the time and adults said "go" 82.5% of the time (U = 13,146, p = 0.006); at Prompt 2, children said "go" 39.7% of the time and adults said "go" 19.8% of the time (U = 11,720, $p < 0.001$).

To examine predictors of participants' use of "go," we ran two generalized linear mixed models separately for children and adults, with participants' use of "go" (versus "stay") as the outcome variable, using Jamovi 2.3.21.0 (The Jamovi Project, 2022).

4.1 | Predictors of children's enforcement of "go" prompts

The child model included the following fixed effect predictors: prompt number (Prompt 1 vs. 2), video type (Depth vs. Breadth), country (Turkey vs. US), and age in years. We also included all two-way interactions between these predictors to examine how they interacted to impact participants' responses. Subject ID was included as a random effect to account for two repeated observations for each individual.

There were significant main effects of prompt number ($\chi^2(1) = 64.05$, $p < 0.001$) and country ($\chi^2(1) = 9.21$, $p = 0.002$). Children were more likely to say "go" at the first prompt compared to the second prompt (92.2% vs. 39.7%, respectively). Children in the US were more likely to use "go" compared to children in Turkey (68.6% vs. 61.7%, respectively). However, these main effects were qualified by a significant interaction between prompt number and age ($\chi^2(1) = 4.70$, $p = 0.03$), and prompt number and country ($\chi^2(1) = 12.54$, $p < 0.001$). There were no significant main or interaction effects of video type (breadth vs. depth) on children's responses (all $p > 0.05$). We ran follow-up analyses to dissect the interactions between prompt number and age, and prompt number and country.

The first simple effect analyses, testing for the effect of age within the first and second prompts separately, showed that age (in years) negatively predicted children's use of "go" at the second prompt ($\chi^2(1) = 6.97$, $B = -0.53$, 95% CI [−0.93 to −0.14], $p = 0.008$), but not at the first prompt ($p > 0.05$). At Prompt 2, children became less likely to say "go" with age. Children's use of "go" did not differ across ages at the first prompt ($p > 0.05$)—indicating that all children enforced "go" at high levels initially, but over time, and possibly due to evidence that exploitation (staying) might pay off, older children switched to enforcing "stay" at higher rates than younger children (see Figure 2).

The second simple effect analysis tested the effect of country within the first and second prompts separately, and showed that the effect of country on the use of "go" was significant at the first prompt ($\chi^2(1) = 12.84$, $B = 2.49$, 95% CI [1.13–3.86], $p < 0.001$), but not at the second prompt ($p > 0.05$). Children in the US were more likely to say "go" at the first prompt compared to children in Turkey (97.9% vs. 83.3%, respectively); by the second prompt, children in both countries said "go" at similar levels (see Figure 3).

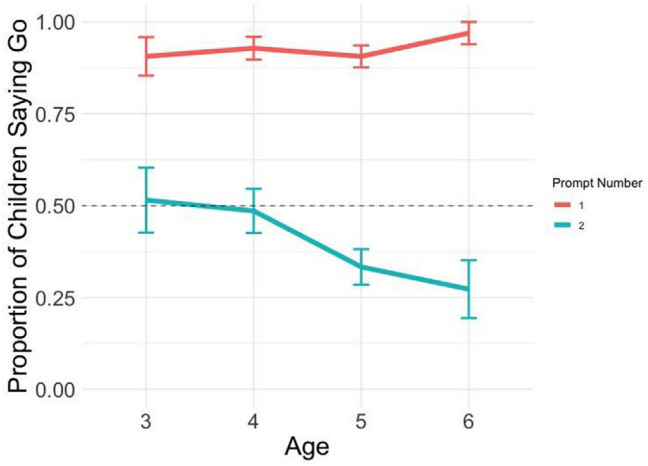

FIGURE 2 The proportion of children enforcing exploration by saying "go," by prompt number and age (in years). At each prompt, children had the opportunity to either say "stay" or "go." All children said "go" at high rates at Prompt 1 (red), but across development, children were less inclined to say "go" at Prompt 2 (blue). Error bars represent standard errors.

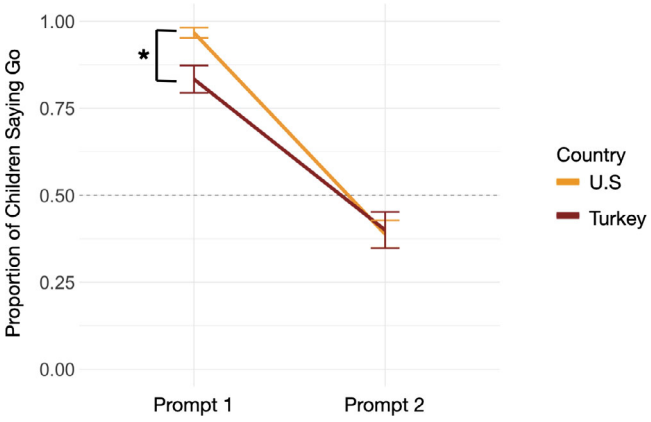

FIGURE 3 The proportion of children enforcing "go," split by prompt number and country. All children were more likely to say "go" at Prompt 1 compared to Prompt 2. Children in the US were more likely to say "go" at Prompt 1 than children in Turkey; children across countries said "go" at similar rates by Prompt 2. Error bars represent standard errors.

4.2 | Predictors of adults' enforcement of "go" prompts

The adult model included the following fixed effect predictors: prompt number (Prompt 1 vs. 2), video type (Depth vs. Breadth), and country (Turkey vs. US). We also included all two-way interactions between these predictors to examine how they interacted to impact participants' responses. Subject ID was included as a random effect to account for two repeated observations for each individual.

There was a significant main effect of prompt number ($\chi^2(1) = 4.98$, $B = -4.55$, 95% CI [−8.54 to −0.55], $p < 0.026$), such that adults were more likely to say "go" at the first prompt compared to the

second prompt (82.5% vs. 19.8%, respectively). No other significant main effects or interactions on adults' responses emerged from the model(all *p*'s > 0.05)—indicating that there were no effects of video type (breadth vs. depth) or country on adults' responses.

5 | DISCUSSION

The current study investigated how children and adults enforce explore versus exploit decisions onto others, and how this pattern differs across early childhood (between 3 and 6 years), developmental stages (children and adults), and sociocultural contexts (Turkey and the US). We adapted a traditional explore-exploit foraging paradigm to be an observational viewing experience, and asked participants whether a search agent should "go" (explore a new environment) or "stay" (stay in a known environment) at various points in the agent's search. Early in the agent's search, when they had searched only one of the five tanks, and experienced consecutive failures within that tank, participants were more likely to tell the agent to "go," rather than "stay." Later in the experiment, when the agent had just entered a new tank and experienced success after a single search attempt, participants shifted their strategy and became more likely to tell the agent to "stay," and exploit that tank.

Critically, key developmental differences—consistent across the US and Turkey—emerged. At both time points in the video, children were more likely than adults to say "go." Later in the experiment, when participants had evidence that exploiting (staying in a tank) was likely to pay off, older children were more likely to enforce "stay" than younger children, who continued to enforce "go" at high rates. In the child sample, we also found a significant interaction between country and prompt number: at the start of the experiment, children from the US enforced "go" at higher rates than children from Turkey; by the second prompt, this effect went away. There were no cross-cultural differences in the adult sample.

Why might children be more likely than adults to enforce exploratory behaviors onto others? Research on children's own exploration routinely shows that children and adults navigate the explore-exploit trade-off differently: younger children are highly exploratory, preferring to explore new environments and information, whereas older children and adults tend to exploit known, rewarding options (Blanco & Sloutsky, 2020; Meder et al., 2021; see also Giron et al., 2023). This preference for exploration is considered a fundamental aspect of learning (Gopnik, 2020), as it allows children to gather a wider range of information about their environment, and learn more about its underlying structure, even if it does not always lead to the highest pay-off of rewards in the short term (Sumner et al., 2019). In the current study, by showing that children *also* encourage others to be exploratory—even as passive observers without any direct benefits or losses to themselves—we provide evidence that children monitor how others navigate the explore-exploit trade-off, and enforce them to be highly exploratory as well.

Our findings revealed developmental differences not only between children and adults, but also across early childhood. Early in the agent's search process, when they had only searched one tank, and had consecutive unsuccessful searches within that tank, nearly all children enforced exploration. By the second prompt, after the agent had explored more tanks and had just experienced success in a newly entered tank, children became less likely to enforce exploration. However, this decrease was not as substantial for younger children. At the second prompt, younger children were more likely than older children to enforce exploration. These developmental differences align with previous work on developmental trajectories of children's own explore-exploit behavior: between 4 and 6 years of age children begin to shift from exploring to exploiting their environment (Liquin & Gopnik, 2022). Though our data cannot speak to the precise reason for these developmental differences, there are several possible explanations. At the second prompt, participants had evidence that the tank in question was likely a high reward environment—the character searched one time in this tank and was successful. It is possible that older children were more sensitive to this evidence of success than younger children, and therefore, were more likely to endorse exploitation behavior in this tank. Another, not mutually exclusive possibility is that younger children's limited inhibitory control (Diamond, 2013) led to an impulsive inclination to say "go" in this context. Alternatively, younger children may consider exploration to be a more advantageous or worthwhile strategy in any context, and therefore continue to enforce it at high rates across the experiment. Future work, for example, examining individual differences in children's ability to detect patterns of success and failure in an agent's search behavior, may shed light on the mechanisms that drive children's early inclination to enforce exploration, and help explain why this orientation changes across early development.

Overall, we found that children in the US and Turkey demonstrated similar patterns of behavior. Though there was a main effect of country on children's behavior, with children from the US enforcing "go" more often than children from Turkey, this effect was qualified by an interaction between country and prompt number. At the first prompt, children from the US enforced exploration more frequently than children from Turkey, with children from the US at near-ceiling in their enforcement of exploration – 98% of children enforced an exploration strategy—whereas only 83% of children from Turkey enforced exploration. At the second prompt, this difference went away, and children from both countries enforced exploration at similar rates. Thus, culture appears to play a small role in shaping children's tendency to enforce exploration onto others. Though our data cannot speak to the reason for these differences, cross-cultural differences in curiosity-promoting educational practices (Schwartz, 1999; Schwartz, 2004; Yenen & Ulucan, 2021) and/or cultural attitudes toward uncertainty avoidance (Hofstede, 2011), might lead children in Turkey to be less exploratory, and therefore less likely to enforce exploration onto others, than children from the US. Future work that more directly measures cross-cultural factors related to the explore-exploit trade-off, as well as cross-cultural differences in children's own behavior in explore-exploit tasks, will provide clearer insights into the role of sociocultural contexts in shaping children's behavior.

The type of video participants watched (breadth vs. depth) did not impact participants' responses, demonstrating that children and adults'

enforcement of explore versus exploit search strategies is stable across subtle variations in an agent's search patterns. It is important to note that the contrast between the two videos was relatively small: the agent searched only two of five tanks in the depth video and three out of five tanks in the breadth video. The overall success, search speed, and number of search attempts was held constant across both videos (i.e. the search duration was matched in length, and the agent was successful in 5 out of 8 searches). To gain a deeper understanding of the role of others' search patterns in decisions about exploration enforcement, future studies with more pronounced contrasts in an agent's search patterns (e.g., searching in one vs. four out of five tanks) can be used to provide better insights into how children and adults update their enforcement strategies in response to differences in search patterns.

5.1 | Limitations and future directions

Though the current study shows that children are more likely to enforce exploration onto others than adults, we are unable to identify precisely why. Future research could test the mechanism underlying this effect by asking participants for the reasons behind their decisions (e.g., through open-ended questions, such as "why did you say 'go'?") or including measures of individual differences (e.g., in ability to detect successful search patterns). Understanding what drives children's enforcement behavior could provide insights into whether children endorse exploration because they believe exploration has learning benefits (e.g., believing that others should explore because they will learn more about their environment as a result), is a social norm that should be followed (e.g., perceiving exploration as a normative aspect of behavior, "This is what one *ought to* do"), or whether some other factor underlies children's motivation to promote exploration (e.g., whether they enforce it simply because that is what they themselves would do, without a cohesive understanding of why).

One additional way to probe the mechanism underlying children's drive to enforce exploration would be to vary the characteristics of the search agent. In the current study, the search agent was presented as a child (with a child-like tone of voice, and a child-like appearance). Future research, that varies the age of the search agent, could test whether children's enforcement of exploration varies as a function of an agent's age. It is possible, because of children's own highly exploratory nature, that they would consistently enforce exploration regardless of the agent's age. Alternatively, it is possible that children adjust their enforcement behavior based on the search agent's age, encouraging children to explore but adults to exploit.

Children may show different patterns of enforcing behavior based on the search agent's age because they have previously seen children act more exploratory, and adults more exploitative, and are therefore reinforcing past behaviors they have seen—possibly viewing those behaviors as "normative"—or, because they have different expectations about children's and adult's prior knowledge. Indeed, the decision to explore versus exploit is highly dependent on prior knowledge, with exploitation being more advantageous when a sufficient amount of background knowledge is present, and exploration being more advantageous when less is known. Research on children's epistemic trust has routinely shown that children hold strong beliefs that adults are reliable sources of knowledge, and will even override what they know to be true in favor of (incorrect) information provided by an adult (Harris & Corriveau, 2011; Jaswal et al., 2010). In the context of exploration, Bonawitz and colleagues (2011) showed that children will constrain their exploration of a new toy if a teacher first demonstrated the function of that toy to themselves or another child, but not if a teacher provided that same demonstration to an adult. These findings highlight that children assume that other children, but not other adults, have comparable prior states of knowledge, and benefit differently from pedagogical instruction. Thus, it is possible that children enforce exploitation when there is evidence an agent has increased prior knowledge (i.e., during adulthood), and enforce exploration when an agent has less prior knowledge (i.e., during childhood). Future work could test this hypothesis by using a similar paradigm with search agents of varying ages and varying background knowledge states.

It is important to note that future research in these directions should pay careful attention to the planning of sample sizes with a priori power analysis. Though we had aimed to test an equal number of adult and child participants in both the US and Turkey, this was not possible because the PI from Turkey relocated from Turkey to a new country at the end of data collection. Thus, the sample size of children in Turkey was smaller than the sample size of children in the US, and the child sample was smaller than the adult sample, raising the possibility that some of our analyses were underpowered, in particular tests of cross-cultural differences in adults' responses across prompts. A descriptive analysis comparing adult responses across the US and Turkey suggests less variability in the adults' responses from the US compared to those from Turkey. Adults from the US were close to ceiling in their responses (88% of participants said "go" at prompt 1; 86% said "stay" at prompt 2), whereas adults from Turkey showed more variability in their responses (77% said "go" at prompt 1; 73% said "stay" at prompt 2). Though these differences were not statistically significant, if these patterns hold when tested with a larger sample, they might suggest cross-cultural differences in the diversity of motives for enforcing explore versus exploit decisions.

5.2 | Conclusion

In conclusion, the current study demonstrated that children across two sociocultural contexts (the US and Turkey) enforce exploration more frequently than adults, and that younger children enforce exploration more frequently than older children. This finding highlights the significance of exploration in children's development, and emphasizes the central role of an "exploration mindset" in children's early decision-making—even when the act of exploring has no direct benefits to the child themselves. Children's exploration supports their ability to develop a deeper, more cohesive understanding of the world around them, and is a crucial component of early curiosity (Lee et al., 2023). Recognizing the significant role of exploration in children's

learning across diverse sociocultural contexts is crucial for constructing theories of early cognitive development, and for designing effective educational strategies that harness children's curiosity.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest pertaining to the research, authorship, or publication of this manuscript.

DATA AVAILABILITY STATEMENT

The data, code, and materials for this experiment are posted on OSF (https://osf.io/jx7he/).

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ENDNOTES

[1] Two families lived in Canada. Due to sociocultural similarities between Canada and the US (Muthukrishna et al., 2020) we kept them in the sample.
[2] One family had recently moved to the UK.
[3] In both languages, a gender-neutral name was chosen. In English, the character's pronouns matched the child's gender; in Turkish, all pronouns were gender neutral. The character was depicted as a child-like character, with a child-like appearance and tone of voice.

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