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Emotional Consensus Matters: Impact on Toddlers' Visual Exploration Behaviors

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Abstract

Emotional feedback plays a critical role in guiding early behaviors, yet relatively little is known about how toddlers integrate emotions from multiple informants. The present study investigated how the consistency of emotional feedback influenced toddlers' visual exploration of novel objects. A total of 74 toddlers (12–24 months) viewed videos of eight adult informants displaying happy, sad, or neutral emotions toward unfamiliar objects. In Experiment 1, toddlers who received consistently sad feedback demonstrated reduced exploration. In Experiment 2, toddlers exposed to inconsistent emotional cues (e.g., 50% happy and 50% sad) exhibited greater exploration compared with those presented with consistent feedback. These findings suggested that toddlers' visual exploratory behaviors were shaped not only by the valence of emotional signals but also by the degree to which these signals were consistent. In particular, a mixture of emotional feedback may enhance toddlers' engagement with novel objects.

Keywords: Emotion, social learning, visual exploration

Introduction

Emotion functions as a primary communicative signal for preverbal infants, exerting a pivotal influence on their behaviors. Although previous research demonstrated that infants and children can leverage emotional cues (e.g., valence) to infer others' beliefs and adjust their own actions (e.g., Liberman, 2023; Mumme & Fernald, 2003; Patzwald et al., 2018; see Wu et al., 2021 for a review), most of these studies have focused on single-informant contexts. In contrast, real-world scenarios typically involve multiple informants whose emotions may converge or conflict. How toddlers integrate these multiple and sometimes divergent emotional cues to guide their behavior remains largely unexplored. To address this gap, the present study examined how emotional feedback from multiple informants influenced toddlers' visual exploration of novel objects.

From birth, humans have exhibited sensitivity to emotional expressions, with newborns distinguishing between negative (e.g., angry) and positive (e.g., happy) faces (Farroni et al., 2007; Field et al., 1982, 1983). By five months, infants can categorize within-valence emotions such as sadness and disgust (e.g., Schwartz et al., 1985; Miguel et al., 2019). By 5–7 months, they match happy and angry vocalizations to the corresponding facial expressions (e.g., Palama et al., 2018, 2022; Soken & Pick, 1992, 1999; Walker-Andrews, 1997). Further, by 12–14 months, infants expect specific emotional reactions—such as disgust following unpleasant tastes or anger in response to thwarted goals (e.g., Ruba et al., 2019; Skerry & Spelke, 2014; Wu et al., 2017). This early emotional sensitivity also supports social learning, as shown in social referencing studies where infants avoid objects associated with negative expressions (e.g., Hertenstein et al., 2004; Hornik et al., 1987; Stenberg et al., 2007).

In contrast to the extensive literature showing that a single individual's emotional cue can shape infants and children's learning and behavior, relatively little is known about whether emotional feedback from a group exerts a similar influence. Studies on the "wisdom of crowds" indicated that pooling information from multiple sources could surpass individual judgments in domains such as financial markets, medical diagnoses, and elections (e.g., Keck & Tang, 2020; Navajas et al., 2018). This variability raises the question of whether group-based emotional cues could provide infants and children with a richer, more nuanced understanding of situations that warrant multiple perspectives.

Research in non-emotional domains have shown that systematic variation enhances infants' learning. In word learning as an example, exposure to diverse speakers (e.g., different genders or accents) helped infants form stable phonological representations (Johns et al., 2016; Twomey et al., 2014). Similarly, seeing varied category exemplars (e.g., different dogs) supports concept generalization (Ankowski et al., 2013; Quinn & Bhatt, 2010). By analogy, exposure to varied emotional expressions across informants may provide toddlers with richer social cues, improving their inferences and adaptive behaviors.

However, emotional signals are fundamentally different from the variable cues used in other domains. In language or object categorization tasks, variations typically preserve a consistent underlying concept (e.g., the word "dog" or the concept of a dog), whereas emotional variability can introduce inconsistent or even contradictory signals. For instance, one caregiver might smile and interpret a toddler's messy painting as a creative act, while another might express frustration, viewing the same behavior as undesirable. Unlike categorical variations in words or objects, such divergent emotional feedback lacks a stable evaluative core, which could complicate toddlers' ability to integrate and respond to these signals. The effect of such emotional inconsistency on toddlers' behavior remains an open question, highlighting the need for further investigation into how toddlers process and reconcile conflicting emotional cues.

Therefore, in the current study, we examined whether toddlers could integrate emotional cues from eight informants to guide their behavior. Focusing on happiness and sadness—emotions commonly used in social referencing research (e.g., Martin et al., 2008, 2014; Patzwald et al.,

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2018; Sorce et al., 1985) —we modified the classical social referencing paradigm by presenting multiple emotional signals and assessing toddlers' visual exploration of novel objects. Unlike prior studies examining direct interactions, we focused on visual exploration due to COVID-19 restrictions and to capture more immediate, less effortful responses that reflect early stages of information processing. Two experiments were conducted. In Experiment 1, toddlers experienced consistent emotional feedback: they viewed either consistently positive (100%Happy) or consistently negative (100%Sad) signals, establishing a baseline for approach versus avoidance behaviors. In Experiment 2, we introduced mixed conditions to examine the effects of conflicting emotional cues, testing one condition with an equal balance of positive and negative emotions (50%Happy-50%Sad) and another combining negative and neutral expressions (50%Sad-50%Neutral). Different gaze measures, including proportional looking, first fixation, and gaze switching, were used to index distinct aspects of toddlers' visual exploration, such as overall preference, initial responses, and exploration strategies, allowing us to capture subtle differences in how they process emotional cues. We predicted that consistent emotional signals would guide clearer preferences (e.g., more looking and initial fixations toward negative associated objects), while mixed emotional signals would reduce these preferences and increase gaze switching, reflecting greater uncertainty or information-seeking behavior.

Experiment 1

In previous studies, only one informant associated either positive or negative emotions to novel objects/behaviours (e.g., Mumme & Fernald, 2003; Patzwald et al., 2018; Repacholi, 1998). In Experiment 1, we increased the number of informants who gave emotional signals but kept the consistency between the association between emotions and objects. To be specific, informants performed consistent emotional feedback to the same novel object, which meant only one emotion (e.g., happy) from different informants would be linked to a specific object. In this way, we aimed to replicate previous studies and examine whether the number of informants matters in influencing toddlers' behaviors.

Method

Participant

We recruited 39 full-term toddlers to participant in this experiment (21 females and 18 males. M = 1.47 years, SD = 0.28 years, age range:1 year to 1.97 years). The sample size was determined based on previous studies using similar social referencing paradigm (e.g., Mumme & Fernald, 2003; Repacholi, 1998). Five additional children were recruited but remove from final data analysis due to mother's inference (e.g., pointing to the screen) (N = 1), extensive movements (e.g., faces cannot be captured by web cameras) (N = 2) and missing recordings (N = 2). All participants were recruited from local communities in Canada. Parents identified their children as White (N = 36), Asian (N = 1), Black (N = 1) and Mixed (N = 1).

Materials and design

Videos of eight White female actresses (aged 19–22) were recorded as stimuli, with each actress depicting three emotional states: happy, sad, and neutral. In the *happy* videos, the actress began with a neutral expression facing directed to camara, then looked into a semi-translucent box in front of her and said, "*Hi baby! Look here! Wow, I really love this toy!*" with a happy tone and facial expression. The interaction lasted 5.5 seconds, followed by a 4-second zoom-in on the box as an object slowly emerged (Figure 1A). The *sad* and *neutral* videos followed the same structure but differed in tones and facial expressions. In the *sad* videos, the actress said, "*Hi baby! Look here! Oh, I don't like this toy!*" with a sad tone, while in the *neutral* videos, she said, "*Hi baby! Look here! This is a toy.*" with a neutral tone and expression.

Ten novel objects were randomly selected from The Novel Object and Unusual Name (NOUN) Database (Horst & Hout, 2016). Each object was characterized with different colors, textures and shapes, but was adjusted to be globally similar in size. The novel objects could ensure that our participants would not have previous experience with these objects. Each video would be paired with all ten novel objects, resulting in 240 videos (8 actress × 3 emotions × 10 novel objects).

Procedure

Participants completed two conditions, 100%Happy and 100%Sad. In 100%Happy condition, there were a learning phase and a test phase. During the learning phase, toddlers watched eight videos presented in two blocks: *emotion block* and *neutral block*. In the emotion block, four videos showed four different actresses exhibited happiness when interacted with a novel object (*emotion-related object*). In the neutral block, another four different actresses kept neutral when interacted with another novel object (*neutral-related object*). This allowed children to associate different emotions with two novel objects via a series of videos. The order of two blocks and eight actresses were counterbalanced across participants. In the test phase, both objects were presented side by side for 5 seconds across four trials, with object locations counterbalanced. An attention-getter centered participants' gaze at the start of each trial (Figure 1B).

The procedure of 100%Sad condition was same as it of 100%Happy condition, except for the emotion block in the learning phase, the four actresses all expressed sadness when interacted with the novel object.

Participants were tested remotely via Zoom. Caregivers provided verbal consent, and the experimenter guided the setup to ensure consistency. To align object locations with toddlers' gaze, a brief calibration was conducted using four trials of an animated attention-getter moving across the screen. By comparing the behaviours in calibration session

and recorded looking behaviours, we could know which direction children were looking at during experiment.

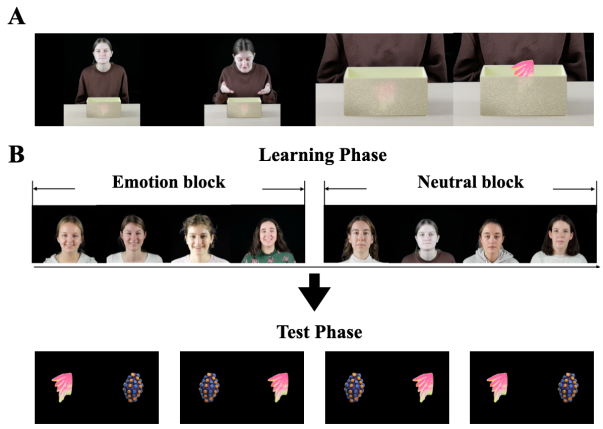


Figure 1. A) An example of video stimuli B) Schematic of learning phase and test phase.

Coding

Children's looking behaviours from recordings were coded using Datavyu (https://datavyu.org/). A primary trained coder coded all video clips, and a second coder coded 10% of the video clip. Reliability between two coders was excellent (r = .969, p < .001). The recordings were coded frame by frame. Five labels were assigned with each frame: "Left", "Right", "Middle" and "NotLooking". For the test phase, we calculated looking time to two different objects by converting "Left" and "Right" labels into "emotion-related object" and "neutral-related object" based on the presented location for each participant. Then we could calculate participants' proportional exploration time towards two types of objects.

Results

No significant difference was found between conditions during the learning phase (p = .805). We then focused on toddlers' visual exploration in the test phase analyzing looking preference, first fixation, and frequency of gaze switches to capture their looking patterns.

Looking preference. To examine whether toddlers' visual exploration was influenced by different emotional signals, we compared their proportional looking time toward emotion-related objects in the test phase to chance level of 50%. One-sample *t*-tests revealed that in 100%Sad condition, toddlers' looking time to the emotion-related objects was marginally significantly below chance level (M = 45.15%, SD = 26.82%; $t(38) = -1.97$, $p = 0.056$, *Cohen's d* = -0.31). In 100%Happy condition, toddlers' looking time to the emotion-related objects did not differ from chance level (M = 46.80%, SD = 25.72%; $t(38) = -1.60$, $p = 0.119$, *Cohen's d* = -0.26, Figure 2A). We further assessed whether the looking time towards emotion related objects differed between the two conditions using paired sample *t*-test. The results showed no significant difference ($t(38) = 0.61$, $p = 0.547$, *Cohen's d* = 0.10).

First fixation. First fixation referred to the initial direction toddlers looked or fixated on when two objects were presented on the screen during each test trial. We calculated the proportion of trials in which participants' first fixation was directed to emotion-related objects and neutral-related objects separately. To examine whether toddlers behaved differently in 100%Happy and 100%Sad conditions, we compared the proportions against the chance level at 50% (e.g., gazed firstly at two objects for equal number of trials) using one-sample *t*-tests. The results showed that in 100%Sad condition, the proportion of toddlers' first fixations towards neutral-related objects was significantly higher than chance level (M = 58.82%, SD = 49.38%, $t(38) = 2.58$, p = 0.014, *Cohen's d* = 0.41, Figure 2B). However, in 100%Happy condition, the proportions did not differ from the chance level (p = 0.325).

Moreover, we examined whether there was a significant difference between the proportions towards emotion-directed objects in 100%Happy and 100%Sad conditions. A paired sample *t*-test suggested that toddlers were more likely to look firstly at emotion-related objects in 100%Happy condition (M = 53.59%, SD = 50.03%), compared with 100%Sad condition (M = 41.18%, SD = 49.38%, $t(38) = 2.46$, $p = 0.019$, *Cohen's d* = 0.39; Figure 2B).

Frequency of gaze switch. Gaze switch referred to toddlers shifting their visual attention from one object to another. Previous research used it to assess how infants allocate attention, process differences during exploration, and identify which objects are more engaging or interesting to them. (e.g., Csibra & Volein, 2008; Rochat et al., 1997; Rochat & Morgan, 1995). We calculated the average number of gaze switches between the left and right sides during the test phase for each participant. A paired sample *t*-test showed that toddlers switched their gazes more frequently in 100%Happy (M = 2.90, SD = 1.24) than in the 100%Sad condition (M = 2.51, SD = 0.99; $t(38) = 2.29$, p = 0.028, *Cohen's d* = 0.37, Figure 2C). This result suggested that in 100%Happy condition, toddlers were more likely to shift their gaze between objects, while in 100%Sad condition, they tended to focus more on the objects on one side.

Discussion

In Experiment 1, toddlers showed reduced visual exploration of objects paired with consistent negative emotions (100%Sad) compared to those associated with neutral cues, while exploration of objects paired with consistent positive emotions (100%Happy) did not differ from those linked to neutral expressions. This suggests that consistent negative signals discouraged exploration, whereas positive signals did not enhance it, aligning with prior findings of an asymmetrical effect—negative emotions tend to restrict engagement, whereas positive emotions do not necessarily promote it (e.g., Boccia & Campos, 1989; Feinman & Lewis, 1984; Hornik et al., 1987; Mumme et al., 1996, 2003). However, it was still unclear whether the number of negative

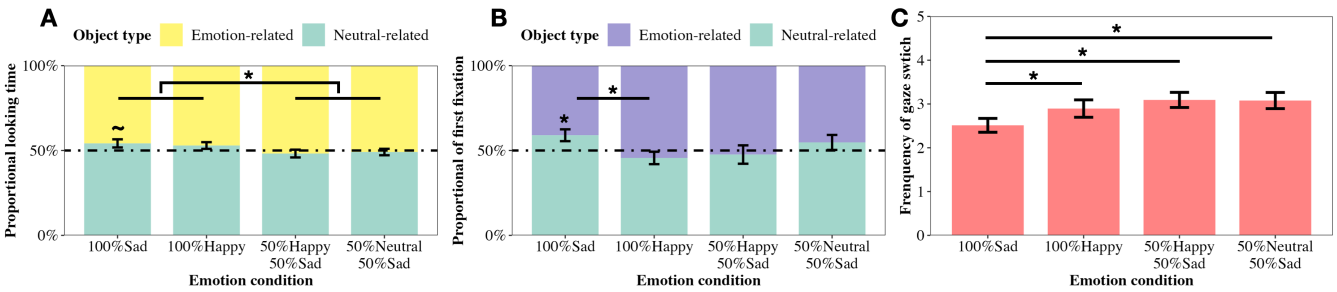


Figure 2. A) Mean proportional looking times towards emotion-related and neutral-related objects during test phase across four conditions, the dashed line indicated chance level. B) Mean proportional of first fixations towards emotion-related and neutral-related objects during test phase, the dashed line indicated chance level. C) The frequency of gaze switch in four conditions during test phase.

informants modulated this effect or whether mixed emotional signals could mitigate negativity. To explore this, Experiment 2 examined (a)whether reducing negative signals affected exploration and (b)how conflicting emotional signals influenced behavior.

Experiment 2

Method

Participant

A new group of 35 full-term toddlers (24 females and 11 males. *M* = 1.23 years, *SD* = 0.26 years, age range:1 year to 2.02 years) were recruited. Two additional children were removed from final data analysis due to extensive movements (*N* = 1) and bad recording quality (*N* = 1). All participants were recruited from local communities in Canada. Parents identified them as White (*N* = 26), Black (*N* = 1), Asian (*N* = 1) and Mixed (*N* = 7).

Materials and design

The video stimuli were identical to those of Experiment 1.

Procedure

The procedure was identical to that of Experiment 1. The only difference was that participants completed two new conditions in the current experiment, *50%Happy-50%Sad* and *50%Sad-50%Neutral*.

In the 50%Happy-50%Sad condition, toddlers watched two happy videos and two sad videos in emotion block during the learning phase; while in 50%Sad-50%Neutral condition, two sad videos and two neutral videos would be presented in emotion block during the learning phase.

Coding

Two research assistants coded recordings following the same coding schema from Experiment 1. Reliability between two coders was showed a high consistency (*r* = .959, *p* = .009).

Results

No significant difference was found between conditions during the learning phase (*p* = .493). The same gaze parameters as Experiment 1 were examined to explore toddlers' looking patterns.

Looking preference. We first calculated toddlers' percentage of looking time to emotion-related objects in the test phase. One-sample *t*-tests similar to that conducted in Experiment 1 revealed that toddlers did not show any significant preference in either 50%Happy-50%Sad condition (*M* = 51.52%, *SD* = 25.37%; *t*(34) = 0.78, *p* = 0.438, *Cohen's d* = 0.13), or 50%Sad-50%Neutral condition (*M* = 50.89%, *SD* = 24.95%; *t*(34) = 0.48, *p* = 0.638, *Cohen's d* = 0.08, Figure 2A). Additionally, a paired sample *t*-test showed that there was no significant difference of the proportional looking time towards emotion-related objects between the two conditions (*t*(34) = 0.32, *p* = 0.751, *Cohen's d* = 0.05).

First fixation. We then calculated the proportion of trials in which the first fixation was directed to emotion-related objects and neutral-related objects respectively. One-sample *t*-tests against the chance level (50%) showed that in 50%Happy-50%Sad condition, toddlers first gazed at the emotion-related objects in 52.24% (*SD* = 50.14%) trials, which is not significantly different from chance level (*t*(34) = 0.44, *p* = 0.663, *Cohen's d* = 0.07). Similarly, in 50%Sad-50%Neutral condition, no significant difference was found (*M* = 45.52%, *SD* = 49.99%; *t*(34) = -1.08, *p* = 0.289, *Cohen's d* = -0.18, Figure 2B). Moreover, A paired sample *t*-test revealed no differences between the proportions towards emotion-directed objects in the two conditions (*p* = 0.336).

Frequency of gaze switch. We finally compared the frequency of gaze switches between 50%Happy-50%Sad and 50%Sad-50%Neutral conditions using a paired sample *t*-test. There was no significant difference between the two conditions (50%Happy-50%Sad: *M* = 3.09, *SD* = 1.02; 50%Sad-50%Neutral: *M* = 3.08, *SD* = 1.09; *t*(34) = 0.07, *p* = 0.941, *Cohen's d* = 0.01, Figure 2C). These results indicated that toddlers switched comparable gazes when exposed to inconsistent emotional signals.

To further explore whether reduced negative emotions and consistency of emotional signals influenced children's visual exploration, we compared the looking behaviours between Experiments 1 and 2.

Looking preference between Expts 1 & 2. To explore whether a decrease in negative emotional signals would lead to a reduction in toddlers' exploration, we compared

participants' proportional looking time directed towards emotion-related objects in 100%Sad condition with both the 50%Happy-50%Sad condition and 50%Sad-50%Neutral condition. Independent-sample *t*-tests indicated that the proportional looking time in 50%Happy-50%Sad condition was marginally significantly higher than it in 100%Sad condition ($t(72) = 1.95$, $p = 0.055$, *Cohen's d* = 0.45; Figure 2A). However, no difference was found between 100%Sad and 50%Sad-50%Neutral conditions ($t(72) = 2.37$, $p = 0.075$, *Cohen's d* = 0.42).

We next examined the potential impact of the consistency on toddlers looking preference during test phase. We combined 100%Happy and 100%Sad in Experiment 1 as consistent condition, and another two conditions (50%Happy-50%Sad and 50%Sad-50%Neutral) in Experiment 2 were combined as inconsistent condition.

An independent-sample *t*-test was conducted to compare the proportional looking time towards emotion-related objects between consistent and inconsistent conditions. We found that toddlers looked significantly longer at the emotion-related objects when provided with inconsistent emotional signals ($M = 51.35\%$, $SD = 9.27\%$), compared with consistent emotional signals ($M = 46.11\%$, $SD = 10.70\%$; $t(72) = 2.24$, $p = 0.028$, *Cohen's d* = 0.52, Figure 2A)

First fixations between Expts 1 & 2. We then calculated the proportion of trials in which the first fixations were directed to emotion-related objects during test phase in each condition. To examine whether reduced emotional signals differently impact toddlers' exploration behaviours, independent-sample *t*-tests were conducted to compare first fixations in 100%Sad condition with both the 50%Happy-50%Sad condition and 50%Sad-50%Neutral condition. The results revealed no significant differences neither between 100%Sad and 50%Happy-50%Sad conditions ($t(72) = 1.78$, $p = 0.080$, *Cohen's d* = 0.41), nor between 100%Sad and 50%Sad-50%Neutral conditions ($t(72) = 0.72$, $p = 0.471$, *Cohen's d* = 0.17; Figure 2B).

Another independent-sample *t*-test was performed to compare the first fixations between consistent and inconsistent conditions. No significant difference was found (consistent condition: $M = 47.44\%$, $SD = 15.40\%$; inconsistent condition: $M = 48.81\%$, $SD = 19.69\%$; $t(72) = 0.34$, $p = 0.738$, *Cohen's d* = 0.08), suggesting the consistency did not bias children's tendency to first gazed at related objects.

Frequency of gaze switch between Expts 1 & 2. Independent-sample *t*-tests similar to that performed on first fixation were performed to compare the frequency of gaze switch in 100%Sad condition with both the 50%Happy-50%Sad condition and 50%Sad-50%Neutral condition. We found that in 50%Happy-50%Sad condition, toddlers switched their gazes more frequently than their counterparts in 100%Sad condition ($t(72) = 2.48$, $p = 0.015$, *Cohen's d* = 0.58). And the frequency of gaze switch in 50%Sad-50%Neutral condition was significantly higher than it in 100%Sad condition ($t(72) = 2.34$, $p = 0.022$, *Cohen's d* = 0.54; Figure 2C).

We further explored whether consistency would affect toddlers' gaze switch. An independent-sample *t*-test showed that the frequency of gaze switch in consistent condition ($M = 2.70$, $SD = 1.13$) was not significantly different with that of inconsistent condition ($M = 3.09$, $SD = 1.05$; $t(72) = 1.73$, $p = 0.088$, *Cohen's d* = 0.40).

Discussion

In Experiment 2, we presented toddlers with conditions featuring both reduced negative signals and conflicting emotional cues from multiple informants. Under these mixed conditions, toddlers did not show a clear preference or avoidance when interacting with the objects. However, comparisons between conditions with full versus reduced negative signals revealed notable differences in looking preferences and gaze-switch frequency, indicating that toddlers integrated emotional cues from multiple sources when guiding their behavior. Furthermore, the results suggested that the consistency of emotional signals significantly affected exploratory behavior; specifically, inconsistent feedback appeared to encourage greater exploration of the objects. Together, these findings underscore the importance of emotional consistency in shaping toddlers' visual exploration and point to the need for further research into how mixed emotional cues influence early social learning.

General Discussion

In this study, we investigated whether toddlers aged 12–24 months could integrate emotional feedback from multiple informants to guide their exploratory behavior. Our findings revealed three key points. First, consistent negative signals (e.g., sadness) appeared to inhibit exploration, whereas mixed signals (both positive and negative cues) did not show the same suppressive effect. Second, toddlers might develop the ability to integrate emotional cues from various sources. Finally, the consistency of emotional input played a critical role—when emotional signals were inconsistent, toddlers engaged in more exploration compared to when signals were uniformly expressed. This pattern is reminiscent of everyday situations, such as when a toddler encounters a smiling caregiver alongside a frowning bystander, prompting them to investigate their environment further.

Previous research has largely focused on the influence of specific emotions or the valence of emotions on social learning (e.g., surprise: Wu & Gweon, 2021; positive vs. negative: Hamlin et al., 2007, 2010; Mumme & Fernald, 2003; Repacholi et al., 2016). In contrast, our work shows that the consistency of emotional signals also significantly modulated exploratory behavior. The increased exploratory tendencies and gaze-switch frequency in the presence of mixed emotional signals suggested that toddlers were not merely reacting to individual cues in isolation but were actively cross-referencing and integrating emotional input from multiple informants. This pattern reflects the "wisdom of crowds" principle—where combining diverse inputs leads to better judgments (Keck & Tang, 2020; Navajas et al.,

2018). As collective input can improve decision-making in adults, variability in group-based emotional cues may foster richer cognitive engagement in toddlers. Drawing parallels from language learning—where exposure to inconsistent input can promote more flexible acquisition of new words (Austin et al., 2022; de Bree et al., 2017; Singh, 2008) and adaptive learning strategies (Tummeltshammer & Kirkham, 2013)—our findings suggested that variability in emotional cues may similarly foster cognitive engagement and adaptive responses. In real-world contexts, where emotional feedback is rarely uniform, such variability might encourage toddlers to explore and learn in dynamic social settings.

Furthermore, the absence of a significant differences between the two mixed emotion conditions (e.g., 50%Happy-50%Sad & 50%Sad-50%Neutral) indicated that it was not the presence of positive or negative emotions alone that drives exploration, but rather the inconsistency between signals. The emotional inconsistency may create a scenario of uncertainty, encouraging toddlers to engage in more information-seeking behaviours as they attempt to resolve the ambiguity. This ability to detect and respond to conflicting emotional feedback may serve as an early foundation for adaptive social learning, equipping toddlers with strategies to navigate social uncertainty.

Emotional information is conveyed through multiple modalities—including facial expressions, vocal tones, gestures, and even written text (Dael et al., 2013; Schirmer & Adolphs, 2017; van Kleef & Côté, 2022)—and processing these complex signals requires advanced cognitive skills. Although infants can associate and integrate emotional cues across modalities (Grossmann, 2010; Grossmann et al., 2006), they also encountered varied emotional expressions from multiple people in everyday life. For example, during a family gathering, a toddler might see different relatives express distinct emotions about the same event. The ability to synthesize these diverse signals is crucial not only for understanding one's immediate social environment but also for learning cultural norms and values. Our study provides initial evidence that the capacity to integrate emotional signals from multiple sources may emerge in toddlerhood.

One notable aspect of our study is its unique developmental context. The toddlers in our sample were raised during the COVID-19 pandemic—a period characterized by limited social interactions outside the family (e.g., Kim et al., 2024; Wang et al., 2020). This restricted exposure may have influenced their sensitivity to the consistency of emotional feedback from multiple informants. In more typical settings, where infants interact regularly with a diverse range of individuals (e.g., extended family members, peers, educators), the impact of consistent versus inconsistent emotional signals might be even more pronounced and could emerge earlier in development. These observations prompt critical questions about whether early exposure to varied emotional environments enhances toddlers' ability to integrate and evaluate emotional cues. Future research should examine if infants in more socially enriched contexts demonstrate similar or heightened integrative skills and whether increased social interactions accelerate the development of these abilities.

Our finding that consistent negative emotions exert a stronger influence on behavior than positive emotions was consistent with previous research on early developmental negative bias (Hertenstein & Campos, 2001, 2004; Hornik et al., 1987; Mumme et al., 1996; Mumme & Fernald, 2003). One plausible explanation is that toddlers, who are typically surrounded by positive expressions in everyday interactions, perceive negative emotions as more salient and consequential. Although one might argue that frequent exposure to positive cues could diminish their impact, our observation of comparable looking times during the demonstration phase across conditions supports the idea that a negative bias—where negative signals more robustly alter behavior and foster generalizable learning (Cacioppo & Gardner, 1999; Vaish et al., 2008; Liberman et al., 2016)—is the more likely mechanism.

A significant difference between the current study and previous research lies in the type of exploration being measured. Whereas earlier studies, such as those by Hornik et al. (1987) and Mumme et al. (1996, 2003), concentrated on physical exploration, our research examined visual exploration. While previous findings clearly showed behavioral differences in toddlers' willingness to physically approach or interact with objects based on emotional cues, our results indicated more subtle differences in visual exploration. This may reflect an earlier stage of processing—where toddlers evaluate emotional information visually before committing to physical action—providing a safer, lower-effort way to gather information in uncertain contexts.

Our work also raised several important questions about how toddlers process complex emotional information. In natural settings, toddlers encounter a broader array of emotional signals than were presented in our study, and the number and diversity of informants increases as they grow. Future research should explore how toddlers organize and interpret this abundance of information and whether factors such as the race or familiarity of the informant (e.g., own-race versus other-race faces, as suggested by Hugenberg & Bodenhausen, 2003; Xiao et al., 2018) further modulate their responses. Such investigations will deepen our understanding of how dynamic emotional input shapes emotion perception and social behavior over the course of development.

In summary, our findings revealed that toddlers integrated emotional cues from multiple informants and adjust their behavior based on the consistency of these signals rather than just their valence. This insight expands our understanding of early social learning and underscores the critical role of emotional consistency as toddlers navigate the complex, often conflicting landscapes of real-world social interactions.

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