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CHILD DEVELOPMENT

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You can't play with us: First-person ostracism affects infants' behavioral reactivity

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Abstract

Ostracism negatively affects fundamental psychological needs, induces physiological and behavioral changes, and modulates the processing of social information in adults. Yet little is known about children and preverbal infants' responses to first-person experiences of ostracism. The current study aimed to explore the efficacy of a triadic ball-tossing game in manipulating social inclusion and ostracism with 13-month-old infants (N=84; 44% males; mostly White; tested from 2019 to 2022) by developing an observational coding system. Infants' behaviors were recorded while participating in a ball-tossing game where they were either included or ostracized from the game. Ostracized, but not included, infants showed an increase in negative emotionality and involvement behaviors, thus suggesting that behavioral responses to being ostracized emerge early in life.

Many of our complex social behaviors are motivated by the need to belong, which lies among the most fundamental human motivations (D'Souza & Gurin, 2016): being accepted into a social group is a crucial aspiration within the human experience. Nonetheless, situations in which individuals are excluded from social relations arise very commonly, across different contexts and developmental stages (Zadro & Gonsalkorale, 2014), threatening the human need to belong and generating diverse negative psychological consequences (Riva & Eck, 2016).

The experience of social exclusion can be either explicit or implicit. Explicit forms of exclusion, such as forbidding someone from taking part in a game, tend to actively preclude the individual from physical closeness to others. Implicit forms of exclusion are bolstered by passive behaviors; in particular, ostracism implies an absence of interest in the individual (e.g., ignoring or overlooking someone) (Williams, 2007). These latter forms of exclusion are deeply unsettling experiences, which compromise individuals' sense of meaningful existence, control, and self-esteem (see Williams & Nida, 2011 for a review), as the human need to hold others' attention is under threat. Literature also suggests that ostracism occurs in different social contexts, spanning from private interactions (Wölfer & Scheithauer, 2013) to public situations (Masclet, 2003), and can be considered a relatively common event. Thus, not surprisingly, human adults are particularly sensitive to cues signaling ostracism and can adaptively react to them in several social situations (Beekman et al., 2016; Cacioppo et al., 2013).

How proficient and sensitive are human infants to social signals of ostracism? It is well known that neglecting social contexts have a dramatic impact on infants' emotional and cognitive development (McLaughlin et al., 2017; Nelson III & Gabard-Durnam, 2020) and that infants immediately react to the interruption of the typical flow of the caregiver-infant relationship (e.g., Mesman et al., 2009). Yet, the question of whether and how preverbal infants detect and react to ostracism situations exerted by unfamiliar individuals in a triadic interaction has never been experimentally and directly tackled. Understanding the precocious reactions to ostracism is fundamental to identifying its consequences on early human development, which, in turn, may be precursors of atypical emotional and cognitive processes, as well as social maladjustment and unsuccessful academic performance (e.g., Burk et al., 2011; Card et al., 2008). Additionally, understanding the

importance of social inclusion may represent a pivotal building block of supportive strategies to protect and sustain infant development. In this perspective, the current study seeks to investigate infants' behavioral reactions to ostracism and inclusion by taking advantage of a classical ball-tossing game introduced to control these social dynamics in a triadic context (Williams & Sommer, 1997).

Results from Williams and Sommer's (1997) seminal study demonstrated that when participants were ostracized they showed less smiling and laughing as well as less engagement (e.g., eye contact and forward lean) compared to included individuals. The validity and versatility of this paradigm are testified by the plethora of studies that have used the online version of the game, the Cyberball (Williams et al., 2000), to experimentally manipulate ostracism in a variety of research fields, including social (e.g., Pancani et al., 2019), clinical (e.g., Seidl et al., 2020), biological psychology (e.g., Geniole et al., 2011), and neuroscience (e.g., Weschke & Niedeggen, 2013).

Although ostracism is a phenomenon thought to be embedded across the entire life span as part of our interpersonal behavior (Williams & Zadro, 2001), research has started only recently to investigate the developmental aspects of ostracism. Using self-report measures, studies on preschool- and school-aged children demonstrated that, similarly to adults, the ostracism manipulation using Cyberball, generated negative affect and threatened the primary needs for belonging, control, self-esteem, and meaningful existence (e.g., Hawes et al., 2012; Pharo et al., 2011; Zadro et al., 2013). In addition, comparably to adults, school-aged ostracized children exhibited improvements in recognition of emotional facial expressions (Mermier et al., 2023), and engaged in more prosocial behaviors, such as action (Hopkins & Branigan, 2020) or language (Watson-Jones et al., 2016) imitation. Furthermore, preschool-aged children not only recognized ostracism (Hwang & Markson, 2020) and assigned a lower emotional state to individuals experiencing exclusion (Hwang et al., 2017; Stengelin et al., 2022), but also showed more affiliative imitation and facial mimicry when ostracized (de Klerk et al., 2020; Over & Carpenter, 2009; Vacaru et al., 2020; Watson-Jones et al., 2016) compared to included children. Importantly, although frustrated verbal and non-verbal behaviors did not appear to be influenced by the ostracism condition, more verbal and non-verbal expressions of anxiety were highlighted in those children ostracized by an in-group compared to an out-group member (Watson-Jones et al., 2016). Thus, the effects of ostracism seem rather stable across developmental stages, with an increase in prosocial and affiliative behaviors and an attunement to social stimuli, at the expense of non-social cues, for both adults and children. Taken together, these studies provided useful insights about preschool- and school-aged children's sensitivity to ostracism exerted by strangers. However, a critical gap exists in our understanding of the emergence of these behaviors in infancy.

Research into the processing of social signals in the first year of life (e.g., Bulf et al., 2015; Mermier et al., 2022; Quadrelli et al., 2019, 2020, 2021) as well as into early mother-infant interactions demonstrates that humans are sensitive to social signals from the first months of life (Mesman et al., 2009). Specifically, consistent evidence using the classical Face-to-Face-Still-Face (FFSF) paradigm shows that the sudden lack of maternal responsiveness elicits specific behavioral (i.e., increased negative affect and reduced smiling) and physiological (e.g., suppression of vagal tone) responses in the first year of life (e.g., Provenzi et al., 2016; Tronick, 2007). While reported results deriving from the FFSF literature provide fundamental insights about infants' sensitivity to social signals within early parent-infant relationships, knowledge about infants' reactivity to social experiences beyond dyadic interactions is still sparse. Importantly, infants' ability to manage triangular dynamics is known to be remarkable (McHale et al., 2008) and by the end of the first year of life, infants are attentive to joint attention phenomena, for example, noticing who is attending or not to whom in triadic exchanges (e.g., Beier & Spelke, 2012). However, to date, no research has investigated, in the very first years of life, the developmental origins of human susceptibility to social ostracism, here defined as the absence of attention and inclusion in a triadic interaction. Paralleling the lack of theoretical knowledge about the origins and development of the response to ostracism, methodological tools enabling us to assess infants' responses to this phenomenon are lacking.

Thus, the current study aims at filling this gap by evaluating the feasibility and efficacy of using an adapted version of the original face-to-face ball-tossing game introduced by Williams and Sommer (1997) to manipulate social inclusion and ostracism in preverbal infants. To this aim, we developed a specific observational coding system to evaluate 13- to 14-month-olds' behavioral reactivity in response to social inclusion or ostracism and to conduct a series of exploratory analyses to assess the degree to which the infant seemed. We selected a sample of 13- to 14-month-olds to ensure that they could actively and independently receive and toss a ball and because research suggests that by the end of the first year, infants are sensitive to social cues in triadic interactions (McHale et al., 2008). Based on research with older children and adults, should the experimental manipulation be successful, we predict that ostracized infants will show an increase in negative emotionality and a decrease in positive emotionality from baseline to the experimental phase. Moreover, we anticipate that ostracized participants will display more negative responses and less positive reactions during the experimental phase than included infants. Furthermore, we expect infants in the ostracism condition to display greater attention to their social partners and greater attention-seeking behaviors compared to included participants.

METHODS

Participants

A total of 84 thirteen- to fourteen-month-old infants (M_{age}=424 days, SD=16 days, range=391–450 days, 37 males, mostly White) were included in the final analysis. All infants were born full-term (37–42 weeks' gestation) and had normal birth weight (>2500 g). We did not collect specific data on sample characteristics, also to comply with the requests of our ethical committee; nevertheless, infants were recruited from a diverse urban environment including the metropolitan and suburban areas of Milano, characterized by approximately 75% of White individuals and different levels of socioeconomic status. Infants were pseudo-randomly assigned to the inclusion (N=43) or the ostracism condition (N=41). The final sample size was in accord with the a priori calculation of the estimated sample size for the interaction effect given two groups (condition: inclusion and ostracism × period: baseline and experimental), which required 84 participants with α=.05 and power=.95 to detect a medium effect (f=.20). Twelve additional infants were tested but discarded from the final sample because of technical problems during data collection (n=4), parents' interference during the task (n=6) or fussiness (n=2). The protocol was carried out in accordance with the ethical standards of the Declaration of Helsinki (BMJ 1991; 302: 1194) and approved by the ethical committee of the University of Milano-Bicocca (Protocol number: 421). Data collection took place at the Bicocca Child & Baby Lab in Milano, Italy, and occurred in two time periods, being interrupted by the COVID-19 pandemic: May 2019 to February 2020, and November 2020 to February 2022. Participants were recruited via a written invitation sent to parents based on birth records provided by the municipal authorities of the city of Milano and by some neighboring municipalities in the northeastern part of the Metropolitan Area of Milano. The study was explained to the parents and their written consent was obtained.

Face-to-face triadic ball-tossing game

The procedure took place at a table and consisted of a face-to-face ball-tossing game between two experimenters and the infant sitting on their parent's lap. All parents were blind to the specific aims of the study. Infants were pseudo-randomly assigned to the inclusion or the ostracism condition. In the inclusion condition, infants received and tossed the ball a third of the time (i.e., 6 times out of a total of 18 throws), so each player participated in the game equitably. The experimenters also made eye contact and smiled with the included participant for the entire duration of the task. In the ostracism condition, after the first two tosses, infants were ignored by the two experimenters, who kept playing together and smiling at each other until they reached 18 throws (Zadro et al., 2013) (Figure 1). The whole task was video recorded to be later coded for infants' behavioral reactions. For the study purposes, the videos were divided into two parts: (1) the *baseline phase*, identical for both the inclusion and the ostracism conditions, consisting of the first six throws; (2) the *experimental phase*, consisting of the inclusion or ostracism manipulation. More details about the procedure are reported in Supplementary Materials.

Affective and behavioral response coding

A specific observational tool was developed to preverbal infants' behaviors during the ball-tossing game. The system allows for micro-analytical coding of the frequency of facial, vocal, and postural expressions and behaviors that infants display in response to inclusion or ostracism (full details are provided in Supplementary Materials).

All coded behaviors were grouped into four indexes as follows: (1) *Positive Emotionality* which refers to infants' behaviors reflecting an underlying positive emotional state. Specifically, it is computed as the sum of the following behaviors: smiling, happy vocalizations, and posture leaning forwards toward the other players. (2) *Negative Emotionality*, refers to infants' behaviors reflecting a negative emotional state. It is computed as the sum of the following behaviors: crying, angry vocalizations, negative facial expressions, slumping posture, withdrawal from the game, and parental help-seeking behaviors. (3) *Active Engagement*, referring to the amount of activity and involvement that the infant displays during the procedure, computed as the sum of the following behaviors: raising arms to ask for the ball, pointing towards the ball, and demonstration of excitement and involvement in the game by pounding the table with their hands. (4) *Visual Attention*, involving a set of skills that enables participants to direct and focus their attention on the social situation. It is computed as the sum of the following behaviors: looking at the ball and looking at the other players.

Each behavior was coded every 2 s with a score of 1 whenever a behavior was present or 0 if it was absent. Separately for the baseline and experimental phases, the scores of the different behaviors were summed up and normalized by dividing the final score by the number of expressed behaviors and then multiplied by 100 to get a percentage score.

DATA ANALYSIS

A series of linear mixed model analyses, with condition (ostracism and inclusion) and phase (baseline and experimental) as fixed effects, and intercept as random effect were conducted on the four indexes. Further statistical analyses related to infants' looking time toward the ball and the other two players are reported in the Supplementary Results. When the mixed models yielded significant effects, pairwise or independent sample comparisons including ≤3

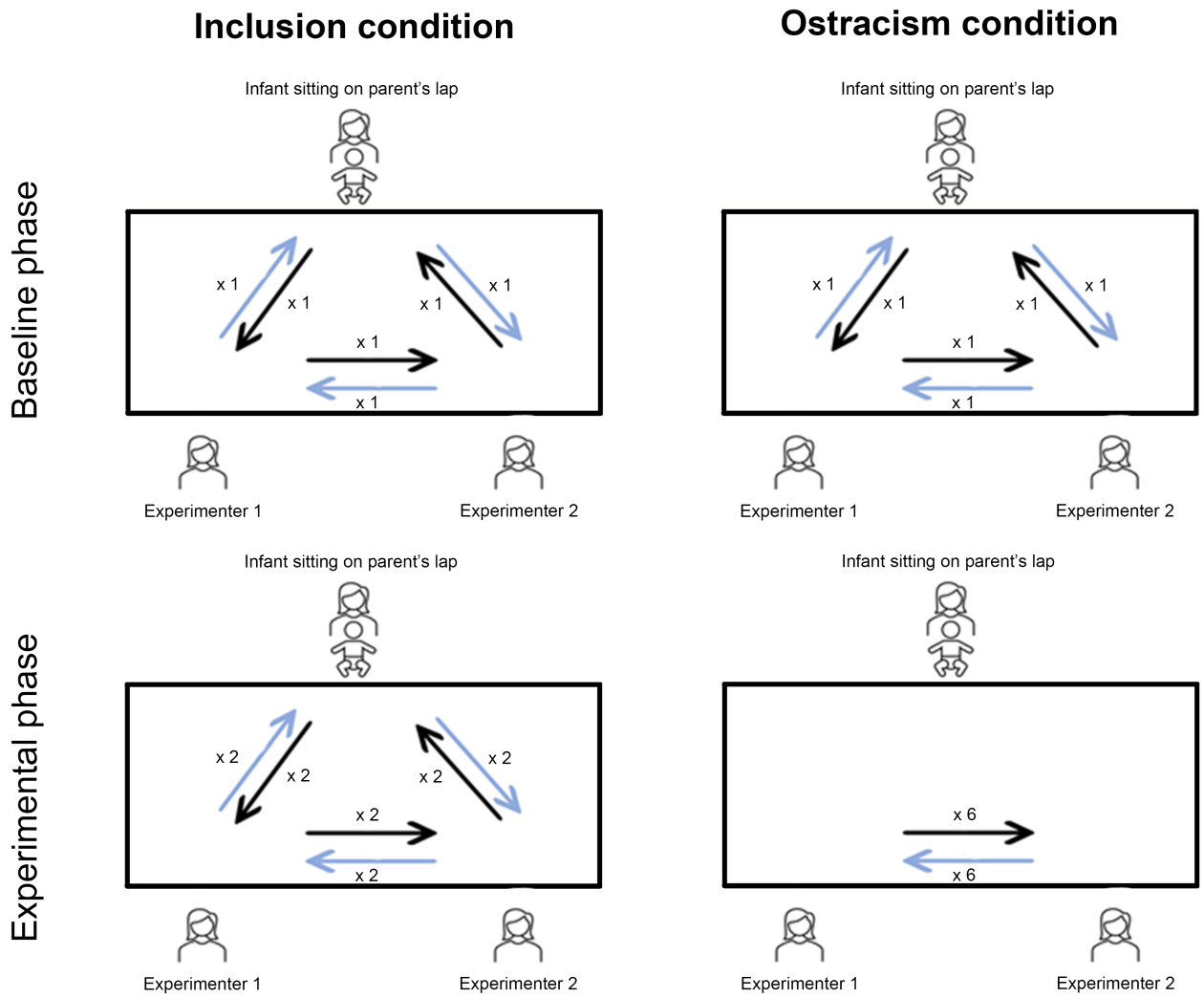

FIGURE 1 Design of the triadic ball-tossing game used in the current study. In the baseline phase, all infants equitably toss the ball both in the inclusion and ostracism conditions. In the experimental phase, included participants keep on playing equitably with the two experimenters, while ostracized infants only observe the two experimenters tossing the ball to each other.

means were performed by applying *t* tests and Fisher's least significant difference procedure (Howell, 2012), and Holm–Bonferroni correction was used where appropriate (Abdi, 2010). Effect sizes were estimated using the Cohen's *d* measure for *t*-tests, and the data are reported as means and standard deviations (SDs). The possible effects of gender on infants' behaviors were also tested. As no significant effects of gender were found (all *p*s > .09), this factor was not retained in the main models. All statistical analyses were performed on Jamovi 2.3 (https://jamovi.org) using a two-tailed .05 level of significance.

RESULTS

Positive emotionality

To test our hypothesis that ostracized infants should exhibit a decrease in their positive emotional state, a linear mixed model was performed on the Positive Emotionality index. The analysis yielded a significant main effect of condition, $F(1, 82) = 12.41$, $p < .001$, with ostracized infants (M = 12.3%, SD = 12.7%) showing less positive behaviors than included ones (M = 21.2%, SD = 14.1%). In addition, a significant main effect of phase was found, $F(1, 82) = 4.13$, $p = .045$, with baseline values (M = 18.0%, SD = 13.6%) being higher than those shown in the experimental phase (M = 15.5%, SD = 14.6%). These main effects were qualified by a significant condition by phase interaction, $F(1, 82) = 41.21$, $p < .001$. Confirming our hypothesis, post-hoc comparisons revealed that ostracized infants showed a significant decrease in positive behaviors from baseline (M = 17.4%, SD = 12.7%) to the experimental phase (M = 7.2%, SD = 10.5%), $t(82) = 5.91$, $p < .001$, $d = .87$, while included participants showed a significant increase in positive behaviors from baseline (M = 18.6%, SD = 14.5%) to the experimental phase (M = 23.9%, SD = 13.4%), $t(82) = -5.31$, $p = .007$, $d = .38$. In addition, a significant difference was also found between ostracized and included infants in the experimental phase,

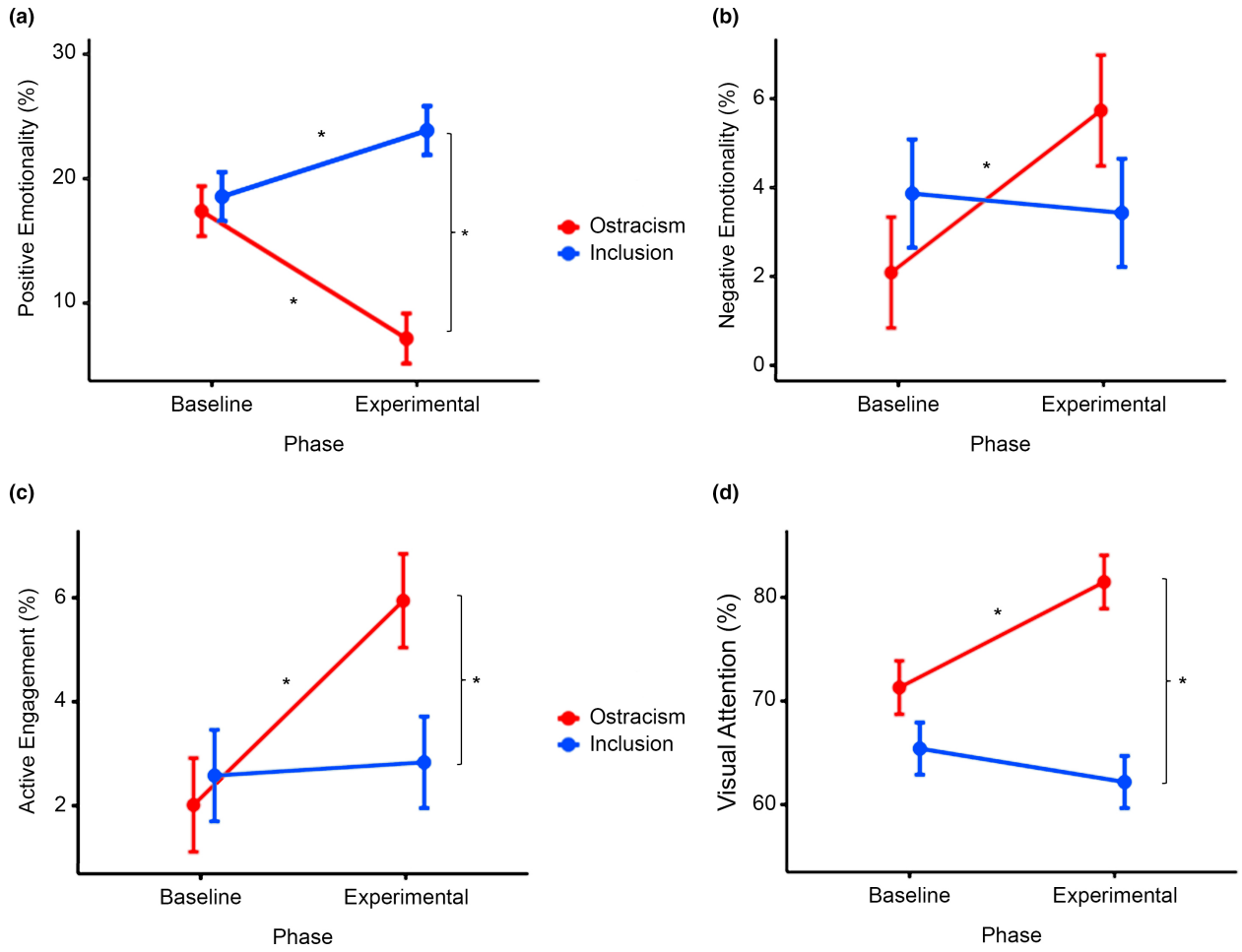

FIGURE 2 Illustrations of the percentage of Positive Emotionality (a), Negative Emotionality (b), Active Engagement (c), and Visual Attention (d) behaviors during the baseline and experimental phases in the inclusion (blue line) and ostracism (red line) conditions. *$p < .05$.

$t(117.5)=4.05$, $p<.001$, $d=1.39$ (Figure 2a). Importantly, no significant difference was observed between included and ostracized infants at baseline ($p=.68$). Overall, these results demonstrate that from as early as 13 months of age, infants ostracized from social interactions with strangers exhibit less positive emotional state (e.g., smiling and laughing) than included ones.

Negative emotionality

To assess whether infants assigned to the ostracism condition exhibited an increase in a negative emotional state, a linear mixed model was conducted on the Negative Emotionality index. Results revealed a significant condition by phase interaction, $F(1, 82)=5.44$, $p=.02$. As hypothesized, post-hoc comparisons revealed that ostracized infants had a significant increase in negative behaviors from baseline (M=2.1%, SD=6.3%) to the experimental phase (M=5.7%, SD=11.2%), $t(82)=-2.91$, $p=.03$, $d=.39$ (Figure 2b). No other comparisons attained statistical significance (all $ps>.94$), and no main effects of phase or condition were found (all $ps>.07$). These results are complementary to those obtained from the Positive Emotionality index. Indeed, they show that when infants go from a phase in which they are actively involved in a social exchange to one in which they are ostracized, they react with an increase in negative behaviors.

Active engagement

To evaluate whether infants allocated to the ostracism condition showed greater activity and attention-seeking behaviors compared to included participants, a linear mixed model was performed on the Active Engagement index. Analysis revealed a significant main effect of phase, $F(1, 82)=8.19$, $p=.005$, with baseline values (M=2.3%, SD=4.1%) being lower than those shown in the experimental phase (M=4.4%, SD=7.2%). In addition, the main effect was qualified by a significant condition by phase interaction, $F(1, 82)=6.32$, $p=.01$. Post-hoc comparisons revealed that ostracized infants showed an increase in active engagement behaviors from baseline (M=2.0%, SD=3.1%) to the experimental phase (M=5.9%, SD=8.9%), $t(82)=-3.76$, $p=.002$, $d=.59$. In addition, as hypothesized, a significant

difference was also found between ostracized (M = 5.9%, SD = 8.9%) and included (M = 2.8%, SD = 4.6%) infants in the experimental phase, $t(148.1) = 2.46$, $p = .015$, $d = .44$. (Figure 2c). No other comparisons attained statistical significance (all $ps > .99$), and no main effect of condition was found ($p = .22$). In sum, observed results demonstrate that upon being ostracized, infants proactively attempted to reconnect with the two players by increasing their attention-seeking behaviors.

Visual attention

In order to assess our hypothesis that infants in the ostracism condition might show greater attention to the social exchange, a linear mixed model was performed on the Visual Attention index. Results revealed a significant main effect of condition, $F(1, 82) = 15.93$, $p < .001$, with ostracized infants (M = 76.4%, SD = 17.8%) showing more visual attention behaviors than included ones (M = 63.8%, SD = 15.9%). A marginally significant main effect of phase was also found, $F(1, 82) = 3.97$, $p = .05$, with baseline values (M = 68.3%, SD = 16.9%) being lower than those highlighted in the experimental phase (M = 71.6%, SD = 18.9%). In addition, these main effects were qualified by a significant condition by phase interaction, $F(1, 82) = 14.75$, $p < .001$. As expected, post-hoc comparisons not only demonstrated that ostracized infants showed a significant increase in visual attention behaviors from baseline (M = 71.3%, SD = 14.7%) to the experimental phase (M = 81.5%, SD = 19.4%), $t(82) = -4.08$, $p < .001$, $d = .59$, but also that a significant difference between ostracized (M = 81.5%, SD = 19.4%) and included (M = 62.2%, SD = 12.8%) infants in the experimental phase was also present, $t(127.9) = 5.35$, $p < .001$, $d = 1.17$ (Figure 2d). No other comparisons attained statistical significance (all $ps > .21$). Like results deriving from the Active Engagement index, current findings suggest that, when ostracized from the game, infants focus their attention more on the social context and the other confederates, possibly in an attempt to reconnect with them and increase the probability of being reincluded in the social exchange (see also Supplementary Results).

DISCUSSION

While decades of research using the FFSF paradigm have clearly demonstrated that infants as early as 1 month of life are sensitive to breaks in the interaction with their mothers (Mesman et al., 2009), how early sensitivity to social signals extend to triadic exchanges with unfamiliar partners, besides the caregiving exchanges, is still unclear. The present research sets out to investigate 13- to 14-month-old infants' behavioral reactions in response to social inclusion or ostracism as manipulated through an adapted version of the ball-tossing game introduced by Williams and Sommer (1997) and assess the degree to which infants appeared to detect and be influenced by the experimental manipulation. Drawing on the presented results, there are clear indications that preverbal infants' behaviors are impacted by exposure to first-person experiences of ostracism as manipulated through a triadic ball-tossing game.

In keeping with the logic that before being rejected, someone must feel accepted by others, all participants were first included during the baseline phase before being either ostracized or continuing to be included. Importantly, for the four examined behavioral indexes, we observed an interaction effect of the experimental condition (i.e., inclusion vs. ostracism) with the procedural phases (i.e., baseline vs. experimental). As hypothesized, ostracized participants showed less Positive Emotionality behaviors compared to included ones and also displayed a decrease in such behaviors from baseline to the experimental phase when they were experiencing ostracism. Overall, these findings are in line with adult data showing that included adult participants exhibit more smiling and laughing, being generally happier, than ostracized ones (Williams & Sommer, 1997), thus suggesting a developmental continuity from early in life to adulthood in the behavioral reactions to ostracism that encompasses the domain of positive affectivity. Unexpectedly, infants in the inclusion condition presented an increase in positive behaviors from baseline to the experimental phase. We might speculate that, as the game proceeded infants warmed up, showed more enjoyment and possibly felt increasingly involved in the experimental phase of the ball-tossing paradigm.

In a similar vein, as predicted, infants who were ostracized exhibited an increase in Negative Emotionality behaviors during the experiment compared to the baseline phase. This result parallels and extends previous findings in school-aged children showing that ostracized participants experienced more anxiety (Watson-Jones et al., 2016) and felt angrier than included participants (Hawes et al., 2012). This result shows that infants as early as 13 months of age are sensitive to ostracism and display an increase in negative affect when confronted with ostracism. Although alternative explanations of obtained findings might be advanced, they do not appear tenable. For example, one may claim that ostracized participants' negative emotionality might have resulted from boredom due to lack of stimulation. While this hypothesis needs to be explicitly addressed in future studies, current results concerning Active Engagement and Visual Attention behaviors do not provide support for this explanation (see also Supplementary Results). Specifically, excluded participants appear to be active and engaged. Indeed, they showed an increase in attention-seeking behaviors and in focusing their attention on the social situation from baseline to the experimental phase, with higher scores

both in Active Engagement and Visual Attention, compared to included participants, in the experimental period. These findings might suggest that infants attempted to reconnect with the two players as soon as they were not considered during the game. Upon being ostracized, infants did not limit to looking more at the ball and the other players but also proactively increased their bids for attention in an attempt to be re-included in the social interaction. Hence, these results parallel and extend evidence from older children showing that motivation to affiliate with others increases following ostracism (e.g., Song et al., 2015; White et al., 2016).

The current findings have important methodological, theoretical, and clinical implications. From a methodological perspective, the results suggest that infants' affective behavioral response to social ostracism can be reliably observed and assessed as early as 13 months. We proposed a new observational tool that, differently from the existing ones designed for older children, does not rely on language skills but allows to assess an individual's facial, vocal, and postural expressions in preverbal children. Thus, the current study may lead the way for future studies employing the adapted triadic ball-tossing game and the current coding system in developmentally atypical populations where language skills might be impaired (e.g., children affected by autism spectrum or language-specific disorders) or to investigate the effects of ostracism on the neural processing of social cues (e.g., emotional expressions and imitative behaviors) early in life. Importantly, while future studies are needed to further validate this new observational tool and possibly disentangle the role of specific isolated variables (e.g., gaze direction or facial expressions) in eliciting the observed effects, our findings showed that infants are sensitive to the inclusion versus ostracism manipulation.

From a theoretical point of view, the current research produced stimulating findings that are relevant to theories about ostracism by extending evidence on the impact of ostracism to preverbal infants and supporting the generalizability of Williams's (2007) model. The current findings are the first to suggest that infants as young as 13 months are sensitive to first-person experiences of ostracism that were found to affect their behavioral and affective reactions, reflecting their internal states and possibly their basic psychological needs. Noteworthy, it can be argued that the observed infants' negative response during the ostracized condition represents a reaction to the experimenters' unresponsiveness, thus mimicking the so-called still-face effect. However, it is important to mention that research into the mechanisms underlying the still face effect showed that infants' interpretation of the reason of the break in the interaction and the identity of the adult (i.e., mother vs. stranger) moderated the strength of infants' response (reviewed in Mesman et al., 2009), with greater negative reactions in response to the still face when played by the mothers and when no obvious reasons for the break in the interaction (e.g., mothers drinking from a bottle or turning to chat with a person) are provided. In this light, while further replication is warranted, the observed negative reaction during the experimental manipulations in the group of ostracized infants is more likely to reflect a true effect of infants' perception of ostracism in a triadic exchange. Future research may now pursue further questions regarding the early development of humans' capacity to respond dynamically to ostracism as a function of their individual characteristics, social development, and social context. For example, personality is known to affect the way adults react to ostracism cues (Yaakobi, 2021). Likewise, attachment style was found to moderate the immediate and delayed ostracism-related distress in adult participants (Yaakobi & Williams, 2016), with avoidant individuals being less affected by ostracism but more distressed by inclusion. As both personality and attachment style are deeply rooted early in life, future research is needed to examine the role of individual and contextual factors in shaping individual differences in infants' behavioral responses to ostracism.

Lastly, ostracism has been shown to carry negative consequences across different domains for the individual who experiences it, spanning from the emotional, cognitive, behavioral, and even neurobiological domains, from childhood to adulthood (Masten et al., 2009; Rudert et al., 2017; Rudert & Greifeneder, 2016; Wölfer & Scheithauer, 2013). Current findings provide evidence that infants as early as 13 months of age are sensitive to social cues related to ostracism experiences, thus highlighting the importance of adopting a developmental perspective in the study of the consequences of ostracism. With the transition from the first to the second year of life, the amount of time that children spend with their peers substantially increases and ostracism is a frequently occurring factor within peer relationships. Thus, future research is needed to identify moderating risk and protective factors concerning ostracism reactions. This would allow to translate these findings into applied fields and enable further projects to develop early prevention-intervention programs.

Some study limitations warrant attention. First, despite the focus of the current work being on infants' reactivity during social interaction, it is to note that there is a bi-directional association between the infant and the two confederates as they are all contributing to the triadic relationship and each other's behavior. Future studies could not only investigate the possible effects of infants' reactions on the experimenters' reactivity but might also examine the role of specific social cues, such as gaze direction or facial expressions in eliciting the observed effects in infants. Second, available literature on infants' behavioral and affective reactions suggests that individual differences might

affect the functioning in other socially stressful paradigms. Hence, further studies are needed to investigate the role of the quality of caregiving (e.g., White et al., 2021) or infant characteristics, such as temperamental traits (e.g., Walker et al., 2014), in influencing participants' sensitivity to ostracism experiences from early in life. Furthermore, future studies might consider the possibility of coding parents' behaviors during the ball-tossing game, as understanding biological and behavioral synchrony/asynchrony in parent–child reactivity might provide interesting insights into this as in other domains of infant research (e.g., Nguyen et al., 2020; Reindl et al., 2022).

CONCLUSIONS

Despite these caveats and limitations, current findings demonstrate the feasibility of using a triadic ball-tossing game as an experimental paradigm to manipulate ostracism from early in life. Overall, this research and the designed coding scheme lay the foundations to provide unique insights into the ontogeny of behavioral strategies employed to navigate social relationships. They also demonstrate that behavioral responses to being ostracized observed in adults emerge early in development, lending further support to the hypothesis that a system for detecting and responding to being ostracized has its roots in the first months of life.

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DATA AVAILABILITY STATEMENT

Data are available from the first author upon reasonable request. The analyses presented here were not preregistered. The materials necessary to attempt to replicate the findings and the analytic code necessary to reproduce the analyses presented in this paper are not publicly accessible.

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SUPPORTING INFORMATION

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