Infants and Toddlers Expect Others Will Shun the Previously Excluded and Instead Approach the Previously Included

Bjørn D. Kristensen (b.d.kristensen@psykologi.uio.no)
Department of Psychology, University of Oslo,
Forskningsveien 3A, 0373, Oslo, Norway

Erik K. Fonn (e.k.fonn@psykologi.uio.no)
Department of Psychology, University of Oslo,
Forskningsveien 3A, 0373, Oslo, Norway

Joakim H. Zahl (j.h.zahl@psykologi.uio.no)
Department of Psychology, University of Oslo,
Forskningsveien 3A, 0373, Oslo, Norway

Lotte Thomsen (lotte.thomsen@psykologi.uio.no)
Department of Psychology, University of Oslo,
Forskningsveien 3A, 0373, Oslo, Norway
Department of Political Science, Aarhus University
Bartholins Allé 7, 8000 Aarhus C, Denmark

Abstract

Navigating social affiliation adaptively is a critical task of human life. If parsing the social world into affiliative groups forms a core, generative mechanism of the evolved human mind, even infants may differentiate between minimal depictions of inclusion and exclusion. Furthermore, whether groups include or exclude others may cue their individual value as social partners. If so, infants may expect third-party observers to continue avoiding those others exclude and prefer those they include, further perpetuating discrimination of the already marginalized. Here, we show that 10-18 m.o. infants (n=96) look longer when a neutral observer approaches a novel agent whom an abstract group previously excluded, rather than included, in an animated violation-of-expectation paradigm. We found no effect of participant age. Movements were identical across scenarios, differing only in a delay between the excluded agent and the group. These findings indicate that even infants infer that observed exclusion versus inclusion will generalize to other interactions with new social partners.

Keywords: infant development; social exclusion; social cognition; cognitive development; marginalization; core cognition

Introduction

Humans are an ultra-social species (Brewer & Caporael, 2013; Tomasello, 2014): We have a fundamental need to belong, and readily form and maintain social relationships (Baumeister & Leary, 1995). Across societies, groups differ in their practices, goals, and stability, but people of all cultures nevertheless naturally form groups and feel distress when relationships come to an end (Hazan & Shaver, 1994). We depend on culture to survive and need group membership not only for security, resources, and mating opportunities but also to access critical cultural know-how and reap the benefits of cooperation (Henrich, 2016; Richerson & Boyd, 2008).

However, if innate motives for social connectedness were leading people to indiscriminately attempt to affiliate with anyone and everybody, then they would risk engaging in cooperative relations with nonreciprocating and exploitative partners. Hence, natural selection likely favored a complex psychological system for acutely detecting and avoiding cheaters and poor cooperative partners while simultaneously seeking out valuable group members who act in cooperative and reciprocal ways (Tooby et al., 2006; Trivers, 1971). One obvious (if imperfect) cue if someone is a valuable group member is whether others exclude or include them, that is, how others evaluated their quality as a social partner and group member.

Here, we investigate whether infants and toddlers infer that a neutral third-party observer will selectively avoid (versus approach) a novel agent whom a social group has previously excluded (versus included), perpetuating the discrimination of the already marginalized. We tested a wide age range of infants and toddlers aged 10 to 18 months to pinpoint the developmental onset of any such potential social inferences.

The function of selective social inclusion

From an evolutionary perspective, selective social inclusion and exclusion play a critical role in upholding cooperation and reciprocal relationships (Kurzban & Leary, 2001; Rand & Nowak, 2013). A powerful tool for securing that a group will function successfully is accepting and socializing cooperative and socially attractive individuals into the group while getting rid of uncooperative and socially unattractive individuals (Nowak & Sigmund, 1998; Tooby et al., 2006). Cooperative, solidary groups suffer from the risk of being

In D. Barner, N.R. Bramley, A. Ruggeri and C.M. Walker (Eds.), *Proceedings of the 47th Annual Conference of the Cognitive Science Society*

exploited by free-riders (i.e. individuals enjoying the benefits of others' costly actions without contributing their proper share), and so motivations to cooperate must have co-emerged with predispositions to evaluate, selectively seek out, and socially include reciprocal altruistic social partners (i.e., partner choice) (Barclay, 2016; cf. also Trivers, 1971). Indeed, both humans and non-human primates seek to affiliate with the most cooperative partners (Melis et al., 2006; Warneken et al., 2006). Insofar as partner choice (i.e., evaluation of potential social partners and selective affiliation with them) is critical for upholding reciprocal, solidary relationships, then people who are (seen as) cooperative should be more likely to be socially included in a group.

Exclusion as social punishment

The evolution and maintenance of cooperation, reciprocal relationships, and social exchange requires that cheaters are discriminated - be it by socially excluding them or by directly inflicting physical punishment (Boyd & Richerson, 1992; Kurzban & Leary, 2001; Trivers, 1971). Without strategic exclusion and rejection of poor cooperators and free-riders, adaptations for cooperation and social exchange could not evolve (because cooperators would be outcompeted).

Consistent with this, if others observe a lack of reciprocation, their inclination to support the defector is reduced, and the risk of punishment and exclusion ensues (Fehr & Gächter, 2000, 2002; Henrich, 2006; Tooby et al., 2006). For such punishment to be effective in stabilizing cooperation, it must ensure a higher cost for the punished than for the one who punished in service of the collective good of maintaining cooperation. Because such punishment is costly to administer, a second-order free-rider problem arises: How can the punishers not be outcompeted by the conflict-shy who free-ride on the punishers' policing? (Boyd & Richerson, 1992; Panchanathan & Boyd, 2004).

One effective punishment meeting these demands in the obligate, ultrasocial human species is exclusion (Feinberg et al., 2014): Both gossip and social exclusion - where one is simply moving away or ignoring the target as group - is less costly to inflict than is the punishment for the excluded target (Panchanathan & Boyd, 2004; Sasaki & Uchida, 2013). Hence, gossip and social exclusion may overcome the second-order free-rider problem, making punishment by social exclusion an evolutionary stable strategy for sustaining indirect reciprocity and cooperation (Panchanathan & Boyd, 2004). Consistent with this, the approval of punishment against anti-social others emerges early in human development (Hamlin, 2014; Hamlin et al., 2011) and is observable across species (Melis et al., 2006; Nishida et al., 1995).

In sum, social exclusion may function as an evolved, key cue across onto- and phylogenesis that one is a non-cooperator and motivate corresponding avoidance by others.

Representations of exclusion and inclusion

A primary challenge for infants and young children is deciphering the relational nature of the social world into which they find themselves. To do so, they must somehow already know what relationships to look for and how to recognize them (Thomsen & Carey, 2013). One potential solution for this *learnability problem* is that evolved core cognition constrains attention to key cues for the critical kinds of social relationships and motivates strategies for navigating the social world appropriately and adaptively (Fiske, 1991; Thomsen, 2020; Thomsen & Carey, 2013). Arguably, detecting instances of social exclusion may be adaptive even from an early age (Baumeister & Leary, 1995; Spoor & Williams, 2007). Consistent with this, three- to five-year-old children detect and evaluate social exclusion and deploy affiliative strategies when observing others being excluded (Hwang et al., 2017; Watson-Jones et al., 2014, 2016; Song et al., 2015; but see Stengelin et al., 2021).

Of course, young children may have learned about social inclusion and exclusion through socialization and their lived experience. However, the conjecture that a universal need to belong is part of human nature suggests that representations of social exclusion versus inclusion may also be innate (in the sense of not requiring extensive social learning from scratch) and facilitate social inferences already in infancy. The core cognition framework argues that humans are endowed with innate representational concepts for evolutionary critical domains, which may emerge already in infancy (Carey, 2009; Spelke, 2022; Spelke et al., 2013; Spelke & Kinzler, 2007; Thomsen & Carey, 2013). Prime candidates in the social domain include representations of social (cooperative and coordinated) groups (Kinzler et al., 2007; Liberman et al., 2017; Powell & Spelke, 2013, 2018) and, we argue here, of why one might be excluded or included in them: Given the critical implications for social belonging, sustaining cooperation, and avoiding exploitation, this perspective suggests that even infants may represent social exclusion and inclusion and infer motivated behavior from it.

Empathic responses to distress

How might infants expect others to react to victims of social exclusion? Young children and infants demonstrate empathetic responses to others in distress (Barragan et al., 2020; Geangu et al., 2010; Roth-Hanania et al., 2011); expect others to respond to those in distress within close, communal relationships (Jin et al., 2018; Thomas et al., 2022); and expect others to help those in need (Köster et al., 2016). Infants themselves also demonstrate a preference for victims and avoid aggressors in the case of physical aggression (Kanakogi et al., 2013). Of course, ostracism is a severe social punishment (Gruter & Master, 1986), so these prior findings suggest that an intuitive, empathic response to victims in distress might lead infants to expect that others will approach and comfort a socially excluded other (as studies show that preschoolers actually do, reviewed above). However, an evolutionary perspective would question whether such naïve altruism could endure in an unconstrained manner (Wynn, 2009; Trivers, 1971).

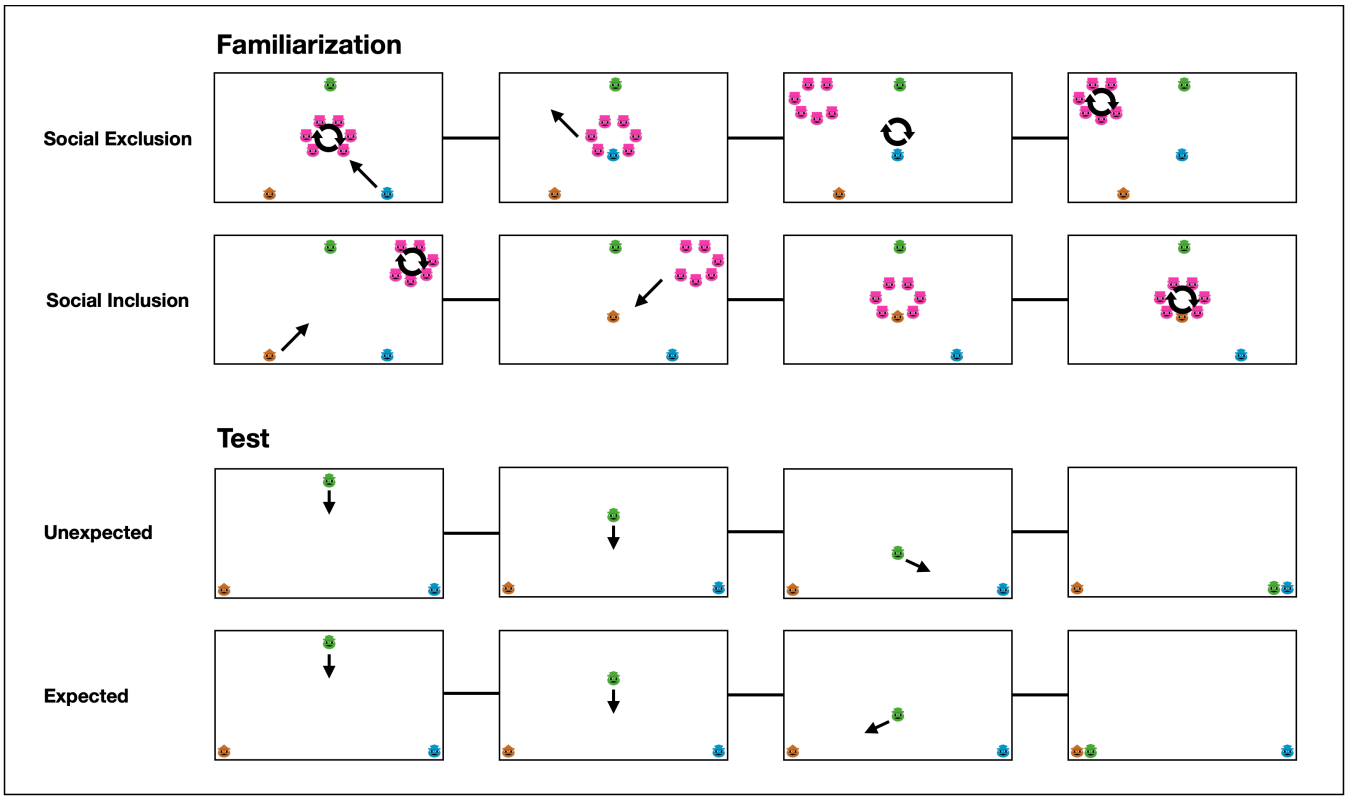

Figure 1: Schematic depiction of stimuli (actual stimuli varied slightly, with figures positioned further apart and presented on a gray background). During the familiarization phase, infants viewed both the inclusion and exclusion scenarios twice, alternating between the two. In the test phase, infants watched a neutral third-party (the green agent) selectively approaching either the previously included agent (expected outcome) or the previously excluded agent (unexpected outcome).

Representations of partner choice

Because the cost of engaging in activities with others who prove to be uncooperative or exploitative can be detrimental, adaptations for detecting and avoiding such social drawbacks would likely evolve and, in principle, manifest even in infancy (Tooby et al., 2006; Trivers, 1971). Consistent with this, infants expect others to preferentially affiliate with those who act prosocially, rather than antisocially (Fawcett & Liszkowski, 2012; Kuhlmeier et al., 2003; Lee et al., 2015), and demonstrate a preference for prosocial others (for meta-analysis, see Margoni & Surian, 2018). Thus, even preverbal infants appear acutely attuned to whether others are potentially cooperative partners.

Here, we posit that infants may also specifically and simply evaluate whether others are included or excluded in affiliative group relations. This is because observing individuals being socially excluded or included may itself confer crucial information whether they are valued social partners, which in turn may indicate critical social attributes such as cooperativeness (Kurzban & Leary, 2001). Of course, individuals may be, and often are, excluded from a group through no fault of their own, as evidenced in many cases of bullying. However, insofar as mistaking a defector for a cooperator is more costly than mistaking an innocent victim for a defector, then inferences from social exclusion may be predisposed towards reducing the former, most costly social error (Haselton & Buss, 2000). Conversely, being included in a group may signal that one is a valuable social partner with whom it would be costly to miss out on cooperation. Thus, even infants may expect others to selectively seek out those who are socially included and shun the socially excluded.

The Present Research

Here, we used a classic violation-of-expectation paradigm (Margoni et al., 2024) to investigate whether 10- to 18-month-old infants would expect neutral third parties to selectively avoid versus approach two agents who had previously been excluded or included by the same social group. We used abstract, minimal stimuli depicting novel agents and a coordinated group to tap whether infants hold abstract core concepts for exclusion/inclusion that may feed into a general basic 'relational grammar' for parsing the social world (Thomsen & Carey, 2013). That is, we asked if infants hold skeletal, generative expectations about social inclusion and/or exclusion that allow them to interpret the meaning of stimuli they have never seen before. If so, they could not have simply learned the social outcomes of these *specific*, concrete examples through their own experience.

On the one hand, if social inclusion and exclusion serve as an important cue of one's value as a social partner, then infants might expect that third-party observers will continue to discriminate against the previously excluded agent and

affiliate with the included agent. On the other hand, if a sympathy response for victims of aggression takes priority in the infant mind, then infants should expect third-party observers to sympathetically approach an excluded agent.

To test these competing predictions, we familiarized infants with animations where one novel agent was included (see inclusion: https://bit.ly/3CJXV7F) and another was excluded (see exclusion: http://bit.ly/3WKCN8g) by the same group. At the same time, a third party observed these events unfold. The group comprised six pink agents moving in a circle across the screen laughing, including one agent in their midst, but excluding the other, moving away whenever it tried to join. The inclusion and exclusion trials were identically matched on both sound and movements, such that the two scenarios *only* differed by the location and movement direction of the group and a timed delay when the excluded agent moved towards the group. In test trials, infants then saw a third party approach the excluded (https://bit.ly/4gpx6U7) or included agent (https://bit.ly/3EmkNL7) once the social group was no longer on the scene (Figure 1).

Methods

Participants

96 healthy infants were included in the study (48 girls, 48 boys, age range 10–18 months, M = 13.1; SD = 2.3). An additional 52 participants were excluded due to fussing out (n = 27), not reaching two included test trials (n = 10), experimenter error (n = 9), technical errors (n = 4), or risk of social influence (n = 2). Infants were recruited from a participant pool of parents who had submitted their contact information via an online form advertised on Facebook, stating their interest in participating in infant studies in our lab. Parents received information about the study before coming to the lab, and gave written consent in person before the testing was initiated.

Materials and procedures

Infants were presented with short, animated videos while seated on their caregiver's lap in an undisturbed lab. To minimize the risk of any social influence, parents were instructed to close their eyes during the test phase of the study and let their infant move as freely and unrestrictedly as possible. Stimuli presentation and looking time codings were conducted in a fully blinded manner. Infants' looking times were coded manually using JHab (Casstevens, 2007).

To investigate whether infants expect others to preferentially approach those who were previously socially included or excluded, the study used a violation-of-expectation paradigm. Infants were presented to four familiarization videos (two depicting social inclusion and two depicting social exclusion, each video lasting 35 s) and two test videos (one video depicting affiliation with an included agent, and one video depicting affiliation with an excluded agent, both videos lasting 36 s) (see Figure 1). For a test trial to be included, infants were required to look for a minimum of 5 seconds. Test videos could be repeated a maximum of three times before terminating the study.

In the familiarization videos, infants were introduced to an included agent (I), an excluded agent (E), a neutral green agent, and a group of six pink agents. All agents were depicted as circular figures with eyes, mouths, and hats, distinguished by their color and the type of hat they wore.

Each video began with the group moving around in a circle while laughing. Depending on the familiarization type (i.e., social inclusion or exclusion), one of the agents (either agent I or E) approached the group. In the inclusion videos, the group also approached agent I and ended up together in a circular formation. Next, they moved around in a circular pattern in unison while laughing. In the exclusion videos, the group moved away from agent E, and agent E moved independently. Next, the group started moving around in a circular pattern while laughing. During both the inclusion and exclusion videos, the neutral green agent was positioned at the top of the screen, gazing towards agent I or E.

Note that the inclusion and exclusion trials were matched in length and had identical soundtracks, movements, and speeds. Inclusion and exclusion trials differed only in (1) the initial location of the group, (2) the direction of the group's movement toward or away from the approaching agent, and (3) the timing of the circular movement for agents I and E.

In test trials, the group was gone, and agents I and E shook slowly while calling (playing a prerecorded female voice) the green agent. The green agent responded by moving slightly closer to both agents. This interaction was repeated twice, and on the third attempt, the green agent selectively moved toward either agent I or E and stood next to it (agent E in the unexpected outcome and agent I in the expected outcome).

We counterbalanced between participants the order of the familiarization videos (whether the social inclusion or exclusion scenario was presented first), position of the included and excluded agents (left or right), color of the agents, and order of the test videos (whether the unexpected or expected outcome was presented first). Combining all possible combinations resulted in 16 conditions—infants were pseudo-randomly assigned to a condition, ensuring six participants in each condition.

We measured infants' looking times when the green agent moved toward either agent. The video's final frame remained on the screen until infants either looked away for two consecutive seconds or continued to look at the screen for a maximum of 70 s.

Results

Analyses were conducted using IBM SPSS (version 30) for all frequentist analyses and JASP (version 0.19.3; JASP Team, 2016) for Bayesian statistical analyses. All figures were created in RStudio (R Team, 2020; RStudio Team, 2020) using the packages ggplot2 (Wickham et al., 2016) and tidyverse (Wickham et al., 2019).

To respect the assumption of normality in parametric statistics, all looking times were Log_{10} transformed prior to

analyses (Csibra et al., 2016). However, untransformed data are used to report means and standard deviations for ease of interpretation. All statistical analyses were two-tailed with Bayes factors reported in addition to frequentist estimates.

Examining the untransformed looking times, infants looked on average 15.94 seconds (*SD* = 11.50) in *Expected trials* when the neutral agent approached the included agent but 18.53 seconds (*SD* = 10.51) in *Unexpected trials* when the neutral agent approached the socially excluded agent.

A repeated-measures ANOVA was run, with looking times to unexpected (approach excluded) and expected (approach included) outcomes as within-subject variables and gender, age, and test order as between-subject factors. This revealed no interaction effects, but a main effect of looking times ($F(1, 63) = 10.03$, $p = .002$, partial $\eta^2 = .137$). Indeed, a paired-samples t-test showed a significant difference ($t(95) = 3.082$, $p = .003$, $d = .315$, 95%CI [0.109, 0.519] between time spent looking to unexpected versus expected test outcomes (see Figure 2), suggesting that infants expected that the neutral third party would approach the agent whom the group had included.

This was further supported by a Bayesian paired samples t-test, which yielded substantial moderate evidence (BF10 = 9.241) in favor of the experimental hypothesis.

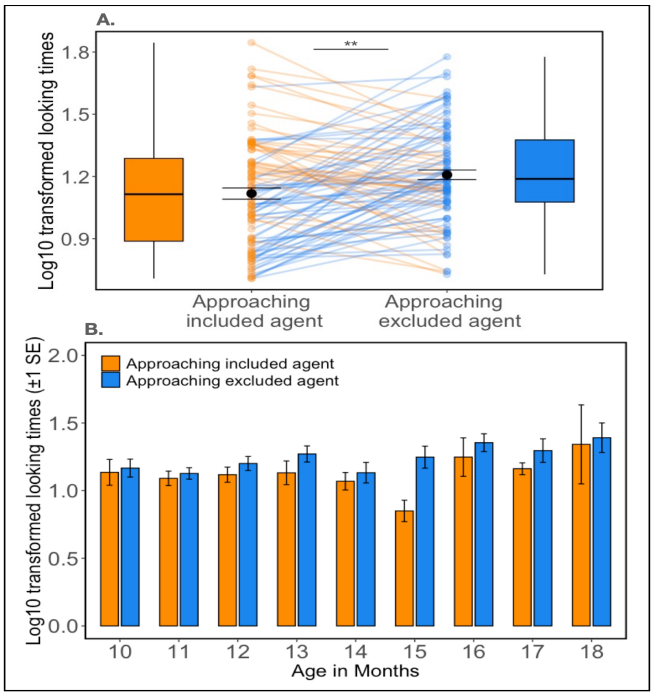

Figure 2: Plot A: Log_{10} transformed looking times for expected (i.e., included agent approached) and unexpected (i.e., excluded agent approached) test outcomes. Boxplots indicate the interquartile range and median. Error bar plot displays mean ±1*SE*. Connected points indicate individual participants. ** = $p < .01$ by paired samples t-test. Plot B: Bar plot of Log_{10} transformed looking times (±1*SE*) broken down by age in months.

Discussion and conclusion

The present study tested a large sample of 96 10–18-month-old infants and provided first evidence that they expect a third party to shun an agent whom others excluded and instead approach an agent whom they included: infants looked significantly longer when a neutral agent approached a previously excluded agent, as compared to approaching an included agent, indicating that the former violated their expectations (Margoni et al, 2024). Infant age did not moderate this pattern of results. Not only do infants differentiate between social inclusion and exclusion, but they also expect that those who have previously been included will be favored, while the socially excluded will continue to face discrimination and shunning from others in new interactions.

The current experimental paradigm held constant the social aspirations and motives of both the excluded and included agents in that they both tried to join the existing, coordinated social group. As a consequence, it remains an open empirical question whether our results reflect a belief that others will shun the ostracized, approach the included, or both because the two outcomes are necessarily conflated when holding constant the affiliation attempts of the included and excluded agents. Note that even if the current results only reflect that infants expect that third parties will prefer an agent whom others include, this would still contrast with the fact that infants do not expect individuals will share other object preferences and goals (e.g., Buresh & Woodward, 2007). That is, these results would still demonstrate dedicated inferences regarding partner choice, licensed by the inclusion granted by other groups. However, in social life, inclusion and exclusion are intricately intertwined, insofar as selectively approaching some entails avoiding others.

Of course, future studies could investigate whether infants still expect that the previously included will be approached and/or the excluded shunned when the two are not conflated: The included or excluded agent could instead be compared to a neutral bystander or another agent who just arrived on the scene. But note that this would make it impossible to control for the affiliative intentions of the excluded or included agent on the one hand (both of whom infants have seen try to join a social group) and the neutral bystander or new arrival on the other (both of whom have demonstrated no such affiliative intentions). Whether a socially disinterested agent or a socially motivated individual who was excluded by others would be seen as the better partner is an open theoretical and empirical question.

In our view, the more interesting theoretical issue is the inferences of partner choice, which are licensed by the inclusion or exclusion of agents with demonstrated intentions and motives for social coordination and affiliation. Any such inferences may only hold if the third party has actually observed the others being excluded and included. Future studies might employ a design where a barrier blocks the third party's view to investigate this. Alternatively, infants might make an even more radical fundamental attribution

error and assume that some individual properties that lead some to exclude an agent will lead all to do so, even if these properties are not yet readily observable for the infant, and even when the infant is making predictions about the behavior of others who have not witnessed any such exclusion. If so, appropriate controls would instead be in the non-social domain to address any potential low-level alternative perceptual accounts of the present results.

Contrary to earlier studies (Hwang et al., 2020), our results indicate that the ability to represent social exclusion may not arise solely as a result of first-hand experience with peer play, but instead manifest already in infancy. Although we tested a wide age range of infants and toddlers aged 10 to 18 months, we did not find any evidence of a developmental onset within this range. Core representations of exclusion/inclusion may therefore emerge even earlier, much like other evolutionarily critical concecpts for navigating the social world adaptively, such as hierarchy and dominance (Thomsen et al., 2011), kinship/communal care (Thomas et al., 2022) and social groups (Powell & Spelke, 2013, 2018). Future studies should investigate whether younger preverbal infants also expect that the previously excluded will be shunned and the included preferred.

This would also align with the notion of an adaptive early-emerging social pain processing system to alert against the potentially fatal dangers of social exclusion (Eisenberger et al., 2003; Eisenberger, 2012; Eisenberger & Lieberman, 2004). It is well established that humans are sensitive towards even minimal signs of exclusion (Williams, 1997; Williams et al., 2000; Wirth et al., 2010; Zadro et al., 2004). Prior research has demonstrated that simply observing third-party social exclusion can elicit feelings of ostracism and distress in adults (Beeney et al., 2011; Eisenberger & Lieberman, 2004; Masten et al., 2010; Wesselmann et al., 2009, 2013). This feeling of social rejection, described as social pain (Dewall, et al., 2010; Eisenberger, 2012; Eisenberger & Lieberman, 2004; Eisenberger et al., 2003), has been proposed to function as a "quick and crude" ostracism detection system (Eisenberger, 2012; Hwang et al., 2020; Kerr & Levine, 2008; Spoor & Williams, 2007; Wesselmann et al., 2009). The fact that even infants represent the social inclusion and exclusion of novel other agents by abstract coordinated groups is precisely what we would expect if humans were indeed hard-wired to detect such cues of social exclusion across specific cultural instantiations.

As one would predict if the social inclusion versus exclusion of others confers sufficient adaptively critical information (Kurzban & Leary, 2001) to merit core representations of it, infants in the current study expected that a neutral observer would discriminate others on grounds of their previous (lack of) affiliation, approaching the included agent and avoiding the socially excluded one. This finding aligns with the concept of an early emerging complex psychological system for acutely detecting and avoiding poor cooperative partners while simultaneously detecting and seeking out valuable group members (cf. Tooby et al., 2006; Trivers, 1971).

Dovetailing with the current results, emerging evidence suggests that infants form sophisticated and nuanced social evaluations. Rather than simply assessing certain behaviors as intrinsically bad or good, infants make social evaluations that are fundamentally influenced by their opinion and assessment of the target. Consistent with this, although infants prefer victims to physical aggressors (Kanakogi et al., 2013), they also approve of punishing dissimilar others (Hamlin, 2014; Hamlin et al., 2011), expect others to shun norm violators (Köster & Hepach, 2024), and themselves avoid and punish wrongdoers (Kanakogi et al., 2022; Tasimi & Wynn, 2016). This might explain why infants in the current study did not expect others to sympathetically approach the excluded agent. It is not that infants failed to recognize the agent as a victim of exclusion; instead, they may have seen their exclusion as a form of intentional and likely proper social punishment.

In summary, the present results support the notion of an early-emerging psychological system for detecting social inclusion versus exclusion. While this system may aid in identifying and seeking out viable partners for social exchange and reciprocal relations (Barclay, 2016; Tooby et al., 2006; Trivers, 1971), it also underscores how social exclusion and shunning may be perpetuated for victims of marginalization through no fault of their own.

Acknowledgments

This work was supported by the Norwegian Research Council (NFR #231157/F10), the European Research Council (ERC # 101040978-COORDINATE) (both to L.T.). LT was also supported by the Danish National Research Foundation (#dnrf-144). We are grateful to Lars Kolstad Brekke, Flavia Filesi, and Andrea Klokkerhaug Rowe for help with data collection and to all the families who participated in this study.

References

Barclay, P. (2016). Biological markets and the effects of partner choice on cooperation and friendship. *Current Opinion in Psychology*, *7*, 33–38. https://doi.org/10.1016/j.copsyc.2015.07.012

Barragan, R. C., Brooks, R., & Meltzoff, A. N. (2020). Altruistic food sharing behavior by human infants after a hunger manipulation. *Scientific Reports*, *10*(1), 1-9. https://doi.org/10.1038/s41598-020-58645-9

Baumeister, R. F., & Leary, M. R. (1995). The need to belong: Desire for interpersonal attachments as a fundamental human motivation. *Psychological Bulletin*, *117*(3), 497– 529. https://doi.org/10.1037/0033-2909.117.3.497

Beeney, J. E., Franklin, R. G. Jr., Levy, K. N., & Adams, R. B., Jr (2011). I feel your pain: emotional closeness modulates neural responses to empathically experienced rejection. *Social neuroscience*, *6*(4), 369–376. https://doi.org/10.1080/17470919.2011.557245

Boyd, R., & Richerson, P. J. (1992). Punishment allows the evolution of cooperation (or anything else) in sizable

groups. *Ethology and Sociobiology*, *13*(3), 171–195. https://doi.org/10.1016/0162-3095(92)90032-Y

Brewer, M. B., & Caporael, L. R. (2013). An evolutionary perspective on social identity: Revisiting groups. In *Evolution and social psychology* (pp. 143-161). Psychology Press.

Buresh, J. S., & Woodward, A. L. (2007). Infants track action goals within and across agents. *Cognition*, *104*(2), 287-314.

Carey, S. (2009). *The origin of concepts*. Oxford University Press. https://doi.org/10.1093/acprof:oso/9780195367638.001.0001

Casstevens, R. M. (2007). jHab: Java habituation software (version 1.0. 2)[computer software]. *Chevy Chase, MD*.

Csibra, G., Hernik, M., Mascaro, O., Tatone, D., & Lengyel, M. (2016). Statistical treatment of looking-time data. *Developmental psychology*, *52*(4), 521.

Dewall, C. N., Macdonald, G., Webster, G. D., Masten, C. L., Baumeister, R. F., Powell, C., Combs, D., Schurtz, D. R., Stillman, T. F., Tice, D. M., & Eisenberger, N. I. (2010). Acetaminophen reduces social pain: behavioral and neural evidence. *Psychological science*, *21*(7), 931–937. https://doi.org/10.1177/0956797610374741

Eisenberger, N. I. (2012). Broken Hearts and Broken Bones: A Neural Perspective on the Similarities Between Social and Physical Pain. *Current Directions in Psychological Science*, *21*(1), 42–47. https://doi.org/10.1177/0963721411429455

Eisenberger, N. I., & Lieberman, M. D. (2004). Why rejection hurts: A common neural alarm system for physical and social pain. *Trends in Cognitive Sciences*, *8*(7), 294–300. https://doi.org/10.1016/j.tics.2004.05.010

Eisenberger, N. I., Lieberman, M. D., & Williams, K. D. (2003). Does rejection hurt? An FMRI study of social exclusion. *Science*, *302*(5643), 290–292. https://doi.org/10.1126/science.1089134

Fawcett, C., & Liszkowski, U. (2012). Infants anticipate others' social preferences. *Infant and Child Development*, *21*(3), 239-249. https://doi.org/10.1002/icd.739

Fehr, E., & Gächter, S. (2000). Cooperation and Punishment in Public Goods Experiments. *American Economic Review*, *90*(4), 980–994. https://doi.org/10.1257/aer.90.4.980

Fehr, E., & Gächter, S. (2002). Altruistic punishment in humans. *Nature*, *415*(6868), 137–140. https://doi.org/10.1038/415137a

Feinberg, M., Willer, R., & Schultz, M. (2014). Gossip and Ostracism Promote Cooperation in Groups. *Psychological Science*, *25*(3), 656–664. https://doi.org/10.1177/0956797613510184

Fiske, A. P. (1991). *Structures of social life: The four elementary forms of human relations: Communal sharing, authority ranking, equality matching, market pricing*. Free Press.

Geangu, E., Benga, O., Stahl, D., & Striano, T. (2010). Contagious crying beyond the first days of life. *Infant Behavior and Development*, *33*(3), 279–288. https://doi.org/10.1016/j.infbeh.2010.03.004

Gruter, M., & Masters, R. D. (1986). Ostracism as a social and biological phenomenon: An introduction. *Ethology and Sociobiology*, *7*(3–4), 149–158. https://doi.org/10.1016/0162- 3095(86)90043-9

Hamlin, J. K. (2014). The origins of human morality: Complex socio-moral evaluations by preverbal infants. *New frontiers in social neuroscience*, 165-188. https://doi.org/10.1007/978-3-319-02904-7_10

Hamlin, J. K., Wynn, K., Bloom, P., & Mahajan, N. (2011). How infants and toddlers react to antisocial others, *Proceedings of the National Academy of Sciences of the United States of America*, *108*(50), 19931–19936. http://doi.org/10.1073/pnas.1110306108

Haselton, M. G., & Buss, D. M. (2000). Error management theory: a new perspective on biases in cross-sex mind reading. *Journal of personality and social psychology*, *78*(1), 81.

Hazan, C., & Shaver, P. R. (1994). Attachment as an Organizational Framework for Research on Close Relationships. *Psychological Inquiry*, *5*(1), 1–22. https://doi.org/10.4324/9780203311851-20

Henrich, J. (2006). Costly Punishment Across Human Societies. *Science*, *312*(5781), 1767–1770. https://doi.org/10.1126/science.1127333

Henrich, J. (2016). *The Secret of Our Success: How Culture Is Driving Human Evolution, Domesticating Our Species, and Making Us Smarter*. Princeton University Press.

Hwang, H. G., Marrus, N., Irvin, K., & Markson, L. (2017). Three-Year-Old Children Detect Social Exclusion in Third-Party Interactions. *Journal of Cognition and Development*, *18*(5), 515–529. https://doi.org/10.1080/15248372.2017.1368517

Hwang, H. G., Suh, J., Balbona, J., Sodhi, S., & Markson, L. (2020). The crude ostracism detection system: Pupils react to minimal cues of exclusion. *Journal of Social and Personal Relationships*, *37*(4), 1225–1244. https://doi.org/10.1177/0265407519891242

JASP Team (2019). JASP (Version 0.11.1) [Computer software]. Available from https://jasp- stats.org

Jin, K. S., Houston, J. L., Baillargeon, R., Groh, A. M., & Roisman, G. I. (2018). Young infants expect an unfamiliar adult to comfort a crying baby: Evidence from a standard violation-of-expectation task and a novel infant-triggered-video task. *Cognitive psychology*, 102, 1–20. https://doi.org/10.1016/j.cogpsych.2017.12.004

Kanakogi, Y., Okumura, Y., Inoue, Y., Kitazaki, M., & Itakura, S. (2013). Rudimentary Sympathy in Preverbal Infants: Preference for Others in Distress. *PLOS ONE*, *8*(6), e65292. https://doi.org/10.1371/journal.pone.0065292

Kanakogi, Y., Miyazaki, M., Takahashi, H., Yamamoto, H., Kobayashi, T., & Hiraki, K. (2022). Third-party punishment by preverbal infants. *Nature human behaviour*, *6*(9), 1234–1242. https://doi.org/10.1038/s41562-022-01354-2

Kerr, N. L., & Levine, J. M. (2008). The detection of social exclusion: Evolution and beyond. *Group Dynamics: Theory, Research, and Practice*, *12*(1), 39. https://doi.org/10.1037/1089-2699.12.1.39

Kinzler, K. D., Dupoux, E., & Spelke, E. S. (2007). The native language of social cognition. *Proceedings of the National Academy of Sciences*, *104*(30), 12577-12580.

Köster, M., Ohmer, X., Nguyen, T. D., & Kärtner, J. (2016). Infants Understand Others' Needs. *Psychological science*, *27*(4), 542–548. https://doi.org/10.1177/0956797615627426

Köster, M., & Hepach, R. (2024). Preverbal infants' understanding of social norms. *Scientific reports*, *14*(1), 2983. https://doi.org/10.1038/s41598-024-53110-3

Kuhlmeier, V., Wynn, K., & Bloom, P. (2003). Attribution of dispositional states by 12-month-olds. *Psychological science*, *14*(5), 402–408. https://doi.org/10.1111/1467-9280.01454

Kurzban, R., & Leary, M. R. (2001). Evolutionary origins of stigmatization: The functions of social exclusion. *Psychological Bulletin*, *127*(2), 187–208. https://doi.org/10.1037/0033-2909.127.2.187

Liberman, Z., Woodward, A. L., & Kinzler, K. D. (2017). The origins of social categorization. *Trends in cognitive sciences*, *21*(7), 556-568.

Margoni, F., Surian, L., & Baillargeon, R. (2024). The violation-of-expectation paradigm: A conceptual overview. *Psychological Review*, *131*(3), 716.

Margoni, F., & Surian, L. (2018). Infants' evaluation of prosocial and antisocial agents: A meta-analysis. *Developmental Psychology*, *54*(8), 1445–1455. https://doi.org/10.1037/dev0000538

Masten, C. L., Eisenberger, N. I., Pfeifer, J. H., & Dapretto, M. (2010). Witnessing peer rejection during early adolescence: Neural correlates of empathy for experiences of social exclusion. *Social Neuroscience*, *5*(5–6), 496–507. https://doi.org/10.1080/17470919.2010.490673

Mathew, S., & Boyd, R. (2014). The cost of cowardice: Punitive sentiments towards free riders in Turkana raids. *Evolution and Human Behavior*, *35*(1), 58–64. https://doi.org/10.1016/j.evolhumbehav.2013.10.001

Melis, A. P., Hare, B., & Tomasello, M. (2006). Chimpanzees Recruit the Best Collaborators. *Science*, *311*(5765), 1297–1300. https://doi.org/10.1126/science.1123007

Nishida, T., Hosaka, K., Nakamura, M., & Hamai, M. (1995). A within-group gang attack on a young adult male chimpanzee: Ostracism of an ill-mannered member? *Primates*, *36*(2), 207–211. https://doi.org/10.1007/BF02381346

Nowak, M. A., & Sigmund, K. (1998). Evolution of indirect reciprocity by image scoring. *Nature*, *393*(6685), 573–577. https://doi.org/10.1038/31225

Panchanathan, K., & Boyd, R. (2004). Indirect reciprocity can stabilize cooperation without the second-order free rider problem. *Nature*, *432*(7016), 499–502. https://doi.org/10.1038/nature02978

Powell, L. J., & Spelke, E. S. (2013). Preverbal infants expect members of social groups to act alike. *Proceedings of the National Academy of Sciences of the United States of America*, *110*(41), E3965–E3972. https://doi.org/10.1073/pnas.1304326110

Powell, L. J., & Spelke, E. S. (2018). Human infants' understanding of social imitation: Inferences of affiliation from third party observations. *Cognition*, 170, 31–48. https://doi.org/10.1016/j.cognition.2017.09.007

R Core Team (2020). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL https://www.R-project.org/.

Randz, D. G., & Nowak, M. A. (2013). Human cooperation. *Trends in Cognitive Sciences*, *17*(8), 413–425. https://doi.org/10.1016/j.tics.2013.06.003

Richerson, P. J., & Boyd, R. (2008). *Not by genes alone: How culture transformed human evolution*. University of Chicago Press.

Roth-Hanania, R., Davidov, M., & Zahn-Waxler, C. (2011). Empathy development from 8 to 16 months: early signs of concern for others. *Infant behavior & development*, *34*(3), 447–458. https://doi.org/10.1016/j.infbeh.2011.04.007

RStudio Team (2020). RStudio: Integrated Development for R. RStudio, PBC, Boston, MA URL http://www.rstudio.com/.

Sasaki, T., & Uchida, S. (2013). The evolution of cooperation by social exclusion. *Proceedings of the Royal Society B: Biological Sciences*, *280*(1752), 20122498. https://doi.org/10.1098/rspb.2012.2498

Song, R., Over, H., & Carpenter, M. (2015). Children draw more affiliative pictures following priming with third-party ostracism. *Developmental Psychology*, *51*(6), 831–840. https://doi.org/10.1037/a0039176

Spelke, E. (2022). *What babies know: Core knowledge and composition volume 1* (Vol. 1). Oxford University Press.

Spelke, E. S., & Kinzler, K. D. (2007). Core knowledge. *Developmental Science*, *10*(1), 89–96. https://doi.org/10.1111/j.1467-7687.2007.00569.x

Spelke, E. S., Bernier, E. P., & Skerry, A. E. (2013). Core social cognition. In *Navigating the social world: What infants, children, and other species can teach us* (pp. 11–16). Oxford University Press. https://doi.org/10.1093/acprof:oso/9780199890712.003.0003

Spoor, J., & Williams, K. D. (2007). The evolution of an ostracism detection system. In J. P. Forgas, M. Haselton, & W. Von Hippel (Eds.), *The Evolution of the Social Mind: Evolutionary Psychology and Social Cognition*. Psychology Press.

Stengelin, R., Golubovic, A., Toppe, T., Over, H., & Haun, D. B. M. (2021). Priming third-party ostracism does not lead to increased affiliation in three Serbian communities. *Journal of Experimental Child Psychology*, *203*, 105019. https://doi.org/10.1016/j.jecp.2020.105019

Tasimi, A., & Wynn, K. (2016). Costly rejection of wrongdoers by infants and children. *Cognition*, 151, 76-79.

Thomas, A. J., Woo, B., Nettle, D., Spelke, E., & Saxe, R. (2022). Early concepts of intimacy: Young humans use saliva sharing to infer close relationships. *Science* (New York, N.Y.), *375*(6578), 311–315. https://doi.org/10.1126/science.abh1054

Thomsen, L. (2020). The Developmental Origins of Social Hierarchy: How infants and young children mentally represent and respond to power and status. *Current Opinion in Psychology*, *33*, 201–208. https://doi.org/10.1016/j.copsyc.2019.07.044

Thomsen, L., & Carey, S. (2013). Core Cognition of Social Relations. In M. R. Banaji & S. A. Gelman (Eds.), *Navigating the Social World: What Infants, Children, and Other Species Can Teach Us* (pp. 17–26). New York, NY: Oxford University Press.

Thomsen, L., Frankenhuis, W. E., Ingold-Smith, M., & Carey, S. (2011). Big and mighty: Preverbal infants mentally represent social dominance. *science*, *331*(6016), 477-480.

Tomasello, M. (2014). The ultra-social animal. *European Journal of Social Psychology*, *44*(3), 187–194. http://doi.org/10.1002/ejsp.2015

Tooby, J., Cosmides, L., & Price, M. E. (2006). Cognitive adaptations for n-person exchange: The evolutionary roots of organizational behavior. *Managerial and Decision Economics*, *27*(2–3), 103–129. https://doi.org/10.1002/mde.1287

Trivers, R. L. (1971). The evolution of reciprocal altruism. *The Quarterly review of biology*, *46*(1), 35-57.

Warneken, F., & Tomasello, M. (2006). Altruistic Helping in Human Infants and Young Chimpanzees. *Science*, *311*(5765), 1301–1303. https://doi.org/10.1126/science.1121448

Watson-Jones, R. E., Legare, C. H., Whitehouse, H., & Clegg, J. M. (2014). Task-specific effects of ostracism on imitative fidelity in early childhood. *Evolution and Human Behavior*, *35*(3), 204–210. https://doi.org/10.1016/j.evolhumbehav.2014.01.004

Watson-Jones, R. E., Whitehouse, H., & Legare, C. H. (2016). In-Group Ostracism Increases High-Fidelity Imitation in Early Childhood. *Psychological Science*, *27*(1), 34–42. https://doi.org/10.1177/0956797615607205

Wesselmann, E. D., Bagg, D., & Williams, K. D. (2009). "I Feel Your Pain": The effects of observing ostracism on the ostracism detection system. *Journal of Experimental Social Psychology*, *45*(6), 1308–1311. https://doi.org/10.1016/j.jesp.2009.08.003

Wesselmann, E. D., Williams, K. D., & Hales, A. H. (2013). Vicarious ostracism. *Frontiers in Human Neuroscience*, *7*. https://doi.org/10.3389/fnhum.2013.00153

Wickham, H., Averick, M., Bryan, J., Chang, W., McGowan, L. D., François, R., Grolemund, G., Hayes, A., Henry, L., Hester, J., Kuhn, M., Pedersen, T. L., Miller, E., Bache, S. M., Müller, K., Ooms, J., Robinson, D., Seidel, D. P., Spinu, V., ... Yutani, H. (2019). Welcome to the Tidyverse. *Journal of OpenSource Software*, *4*(43), 1686. https://doi.org/10.21105/joss.01686

Wickham, H., Chang, W., & Wickham, M. H. (2016). Package 'ggplot2.' *Create Elegant Data Visualisations Using the Grammar of Graphics. Version*, *2*(1), 1–189.

Williams, K. D. (1997). Social ostracism. In *Aversive Interpersonal Behaviors* (pp. 133–170). Plenum Press. https://doi.org/10.1007/978-1-4757-9354-3_7

Williams, K. D., Cheung, C. K. T., & Choi, W. (2000). Cyberostracism: Effects of being ignored over the Internet. *Journal of Personality and Social Psychology*, *79*(5), 748–762. https://doi.org/10.1037/0022-3514.79.5.748

Wirth, J. H., Sacco, D. F., Hugenberg, K., & Williams, K. D. (2010). Eye Gaze as Relational Evaluation: Averted Eye Gaze Leads to Feelings of Ostracism and Relational Devaluation. *Personality and Social Psychology Bulletin*, *36*(7), 869–882. https://doi.org/10.1177/0146167210370032

Wynn, K. (2009). Constraints on natural altruism. *British Journal of Psychology*, *100*(3), 481– 485. https://doi.org/10.1348/000712609X441312

Zadro, L., Williams, K. D., & Richardson, R. (2004). How low can you go? Ostracism by a computer is sufficient to lower self-reported levels of belonging, control, self-esteem, and meaningful existence. *Journal of Experimental Social Psychology*, *40*(4), 560–567. https://doi.org/10.1016/j.jesp.2003.11.006