

Infant-Parent Emotional Synchrony during Social and Non-social Play

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Introduction

There is growing evidence that early experience of play is related to various developmental outcomes (Lillard et al., 2013; Zosh et al., 2018). During face-to-face interactions such as social play, parents and infants mirror each other's affect, and the interchange of positive affect is considered a defining feature of infant-parent play (Fogel, 1993; Lillard et al., 2013; Zosh et al., 2018). Despite this, we could find no existing studies comparing the expression of positive affect in different play contexts. Furthermore, literature has documented that both infants and parents coordinate their emotional expression according to the partner (Cohn & Tronick, 1988; Feldman, 2007), but few studies compared empirically different play contexts to explore how such mutual coordination may happen in terms of temporality in different play contexts.

Methods (Data Collection)

Research Questions:

1. Are there differences in positive affect expression between social and non-social play?
2. Are both positive and negative emotions mirrored during parent-infant play?
3. What are the temporal dynamics of emotional mirroring (parent to infant vs. infant to parent)?

❖ **Participants:** 20 mother-infant dyads (mean age 10.4 mo)

❖ **Procedures:** Each dyad participated in Social (i.e. joint) and Non-social (i.e. separated) play with toys, while their emotional expressions were monitored on video. EEG was concurrently collected for future analyses (not reported here).



Social Play (left pic): mothers were asked to play together with their infant with a set of toys, in a natural and spontaneous way, but silently (to match the non-social condition). The mean duration of a social play session was 11.4 mins (*SD* 1.2 mins). **Non-social Play** (right pic): a small divider was placed on the table to ensure that parent and child could not establish eye contact but were aware of each others' presence. Mothers and infants were presented with two identical toys (same as the ones used during Social Play) and instructed to play silently on their own. The mean duration of a non-social play session was 11.1 mins (*SD* .89 mins). There was no significant difference in duration across conditions ($t(19) = .929, p = .365$).

❖ **Coding:** Following Neale et al (2018), mothers' and infants' emotional expressions (positive, negative or neutral) were manually coded from video footage with a temporal resolution of 33 milliseconds (30 frames per second). The recordings obtained using the different cameras were synchronised using LED boxes placed behind the infant's and parent's chairs.

- **Positive Affect:** wide-opened eyes, smile or laughter, energetic or emphasised movements such as raising eyebrows in a positive mood.
- **Negative Affect:** frowning, sadness, fussiness, uninterested or unwillingness to play with the other, and tiredness or disengagement (e.g. leaning backwards).
- **Neutral Affect:** neither positive nor negative.

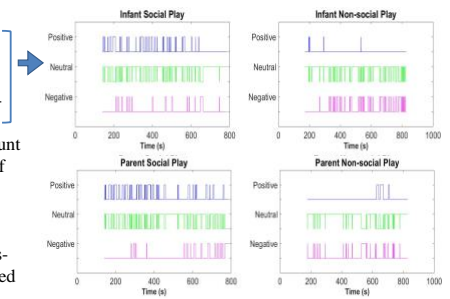


Positive, Neutral and Negative affect (left, centre, right)

Methods (Analyses)

Analyses:

- A. Infant and parent affect expression.** The percentage duration of each emotion (Positive, Neutral or Negative Affect) exhibited by parents and infants was compared across Social and Non-social play conditions.
- B. Synchronicity in parent-infant affect.** The amount of emotional synchrony (i.e. concurrent display of similar affect) between parents and infants was assessed across conditions, considering both positive and negative affect synchrony.
- C. Cross-correlation in parent-infant affect.** Cross-correlation analyses in 1s time lags were performed to investigate temporal dynamics of parent-infant emotional mirroring.



Examples of time-series data obtained on an individual's emotional expression.

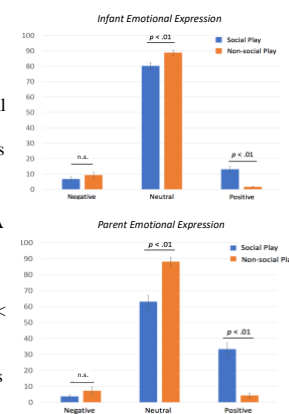
Results

Summary. Our results showed that both parents and infants showed significantly more positive affect and more positive affect synchrony during social play than non-social play. In terms of the temporal dynamics of positive emotional responding, we found that mothers tended to follow, rather than lead, their infants' positive emotional expressions. Further, mothers responded faster to their infants' positive emotions during social play as compared to non-social play. By contrast, there were no significant differences on any of these measures for negative emotions.

A. Infants' and Parents' emotional expressions.

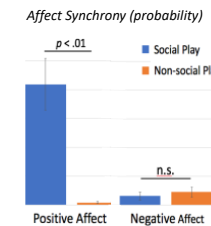
Infants. A repeated-measures ANOVA and a subsequent Tukey HSD post-hoc analysis indicated that infants showed increased positive affect ($p < .001$) and decreased neutral affect ($p < .001$) during Social Play compared to Non-social Play, whereas the display of negative affect did not differ across conditions ($p = .91$).

Parent. A repeated-measures ANOVA and a following Tukey HSD post-hoc analysis suggested that mothers also showed increased positive affect ($p < .001$) and decreased neutral affect ($p < .001$) during Social Play compared to Non-social Play, whereas the display of negative affect did not differ across conditions ($p = .96$).



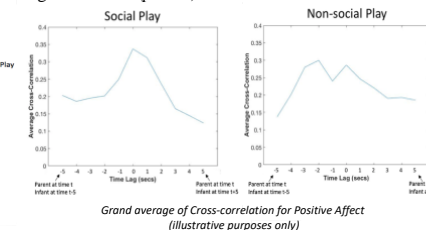
B. Synchrony.

Non-parametric Wilcoxon signed-rank tests (with Bonferroni-corrected significance levels) indicated that the proportional duration with which infant-parent dyads engaged in positive affect synchrony increased significantly during Social Play compared to Non-social Play ($p < .001$). Conversely, the negative affect synchrony duration did not differ across conditions ($p = .438$).



C. Cross-correlation.

A lagged cross-correlation analysis was performed for Positive and Negative Affect. A linear mixed model analyses and a subsequent Tukey HSD post-hoc analysis indicated that when parents played together (as compared to separately) with their infant, their emotions followed and correlated significantly faster with their infants' emotions. However, this faster parental responsiveness was only observed for Positive Affect ($p < .001$), and not for Negative Affect ($p = .86$).



Grand average of Cross-correlation for Positive Affect (Illustrative purposes only)

Conclusion

The study examined whether there are differences in positive affect expression and mirroring between social and non-social play, as well as the temporal dynamics of emotional mirroring between mothers and their infants.

Our results suggest that social play is indeed associated with increased positive affect, increased emotional synchrony, and faster parental emotional responsiveness than non-social play. Notably, these effects were only observed for positive emotions, suggesting that different mechanisms may underpin the exchange of positive and negative affect during parent-infant social play interactions. Further, since different play contexts resulted in different levels of positive affect, this suggests that the social context in play may be a crucial factor in determining play's developmental benefits.

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SF is now working as part of the MOTION project supported by European Commission (Marie Skłodowska-Curie ITN), with a focus on how infants' and adults' brain interact during naturalistic face-to-face interactions. The series of studies planned will likely to involve dual-EEG (hyperscanning) research techniques. If you are interested, please get in touch with SF, or visit <https://www.motion-eu.org/>