

# Association between early signs of autism and physiological synchrony in toddler-parent play

Helminen, T.M., Saaristo, V., Karjalainen, A., Kauppinen, S., Parttimaa, T., Husu, E., & Kylliäinen, A.<sup>1</sup>

Faculty of Social Sciences / Psychology, Tampere University, Finland

## Background

Atypicalities in social interaction and communication, characteristic of autism spectrum disorders, can often be recognized during the first years of life. Previous studies (Quiñones-Camacho et al., 2021; Saxbe et al., 2017; Wang et al., 2021) have indicated that autistic individuals tend to exhibit less physiological synchrony during interactions compared to neurotypicals. In addition, amount of autism traits seems to be associated with synchrony (Baker et al., 2015; Wang et al., 2020).

**Aim:** To investigate the association between early signs of autism and psychophysiological synchrony (PS) measured with electrodermal activity during a parental play session.

## Participants

- The study is a part of the ongoing Gaze@Toddler -project.
- Autistic traits were assessed using the ADOS-2 toddler module at 17 months. Participants were divided into low and high trait groups, based on ADOS-2 toddler module classification: Those who's scores fell into the no/little concern were assigned to low group, and those with little-moderate or moderate-severe, to high group.

Table 1: Descriptives of participant's age when physiological synchrony was measured (*mean, sd*), and ADOS-2 Toddler module algorithm scores (*mean, sd*) at 17-month visit.

	Low traits	High traits
N, total (boys)	14 (7)	8 (5)
Age when PS measured (months)	26.2 (4.2)	27.5 (5.6)
ADOS-2 at 17 months		
Social Affect	4.6 (1.9)	13.4 (2.9)
Restricted and Repetitive Behavior	1.0 (0.9)	1.5 (0.8)
Total	5.6 (2.1)	14.9 (3.1)

## Methods

- Electrodermal activity (EDA) was recorded at 24 or 36 months from 38 child-parent dyads during a 14-minute free play session with a fixed set of toys (designed for BOSCC-analysis). Empatica E4 wristband was positioned to left wrist of the parent and left ankle of the toddler.
- Data quality was inspected with EDA Explorer (Hemmelmann, 2018). Further analysis included 14 low-traits and 8 high-traits dyads, each with over 70% simultaneously valid data.
- Low-quality data (as identified by EDA Explorer) up to 5 sec was replaced with linear interpolation, and longer periods were marked as invalid. Tonic EDA activity was extracted using the FLIRT toolkit (Föll et al., 2021), resulting in a sample rate of 1 Hz.
- Surrogate synchrony analysis of EDA, segmented to 30s segments, was conducted with SUSY, and statistical analyses were conducted with effect sizes (ES) of both absolute and non-absolute correlations (Tschacher & Haken, 2019).

## Results

- Across the entire sample,  $ES_{abs}$  significantly differed from zero ( $M = 0.26, sd = 0.28, t(21) = 4.44, p < .001$ ), while  $ES_{noabs}$  did not ( $md = 3.06, W = 164.00, z = 1.22, p = .223$ ). (Figure 1.)
- Visual inspection of dyad's  $Z_{noabs}$ -values showed that the sign of correlations (indicating whether the synchrony was anti-phase or in-phase) varied within the timeseries (Figure 2.), which explains the difference between  $ES_{abs}$  and  $ES_{noabs}$  results.
- No significant differences were found between the low and high trait groups in both  $ES_{abs}$  ( $t(20) = 0.00, p = 1.00$ ) and  $ES_{noabs}$  ( $U = 52.00, Z = -.273, p = .785$ ).

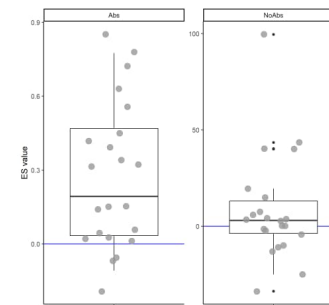


Fig1: Absolute and non-absolute ES-values

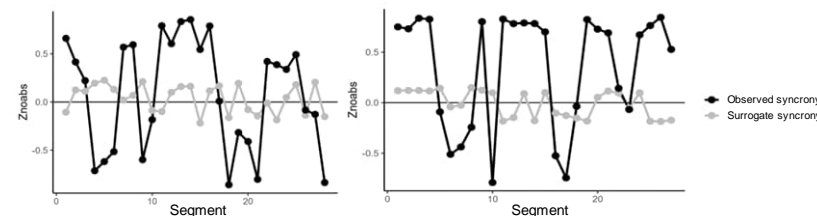


Fig2: Examples from two toddler-parent dyads of  $Z_{noabs}$ -timeseries compared to surrogate time series, which is used in calculation of ES-value.

## Discussion

- Significant PS was observed between children and parents during free play, characterized by a mix of anti-phase and in-phase synchrony.
- However, no association was found between the level of early autistic traits and PS.
- As the high trait group contained toddlers with only little-moderate amount of autism traits, differences between groups' autistic traits might not be large enough.
- Results are restricted by the small sample size and significant data loss due to technical difficulties and signal artifacts.

## References

Baker, J. K., Fenning, R. M., Howland, M. A., Baucom, B. R., Moffitt, J., & Erath, S. A. (2015). Brief report: A pilot study of parent-child biobehavioral synchrony in autism spectrum disorder. *Journal of Autism and Developmental Disorders*, 45, 4140-4146.

Föll, S., Maritsch, M., Spinola, F., Mishra, V., Barata, F., Kowatsch, T., ... & Wortmann, F. (2021). FLIRT: A feature generation toolkit for wearable data. *Computer Methods and Programs in Biomedicine*, 212, 106461.

Hemmelmann, J. H. (2018). *Validity of the EDA-Explorer as a means for artifact rejection and peak detection in electro dermal activity data-analysis* (Master's thesis, University of Twente).

Quiñones-Camacho, L. E., Fishburn, F. A., Belardi, K., Williams, D. L., Huppert, T. J., & Perlman, S. B. (2021). Dysfunction in interpersonal neural synchronization as a mechanism for social impairment in autism spectrum disorder. *Autism Research*, 14(8), 1585-1596.

Saxbe, D. E., Golan, O., Ostfeld-Etzion, S., Hirschler-Guttenberg, Y., Zagoory-Sharon, O., & Feldman, R. (2017). HPA axis linkage in parent-child dyads: Effects of parent sex, autism spectrum diagnosis, and dyadic relationship behavior. *Developmental Psychology*, 53(6), 776-786.

Tschacher, W., & Haken, H. (2019). *The process of psychotherapy*. Berlin, Germany: Springer International Publishing.

Wang, H., Suveg, C., West, K. B., Han, Z., Zhang, X., Hu, X., & Yi, L. (2021). Synchrony of respiratory sinus arrhythmia in parents and children with autism spectrum disorder: moderation by interaction quality and child behavior problems. *Autism Research*, 14(3), 512-522.

Wang, Q., Han, Z., Hu, X., Feng, S., Wang, H., Liu, T., & Yi, L. (2020). Autism symptoms modulate interpersonal neural synchronization in children with autism spectrum disorder in cooperative interactions. *Brain Topography*, 33, 112-122.

