

Behavioural dynamics of emotional self-regulation during the still-face paradigm: Differences at 9-months due to prematurity and effect on 2-year autistic traits

Y. W. Chua¹, L. Ginnell², V. Ledsham², C. Tachtatzis¹, I. Andonovic¹, J. P. Boardman², P. Rowe¹, S. Fletcher-Watson², J. Delafield-Butt¹

¹ University of Strathclyde ² University of Edinburgh

INTRODUCTION

- Infants born preterm are at risk of a triad of clinical and subclinical socioemotional difficulties related to Autism spectrum disorder (ASD), Attention-Deficit Hyperactivity Disorder and Anxiety¹.
- This includes an **8% prevalence of ASD²**.
- **Emotion self-regulation (ER)** is one of the earliest observable risk factors for later socioemotional difficulties in infants born preterm³. Early difficulties with emotion regulation are also common in autistic children⁴.
- **Dynamics** of emotion self-regulatory behaviours can indicate the extent it is flexible and adaptable⁵
- This could provide a novel perspective on how prematurity impacts **system-level characteristics⁶** of emotion self-regulation, in ways that might increase risk for socioemotional difficulties, such as those seen in ASD.

METHODS

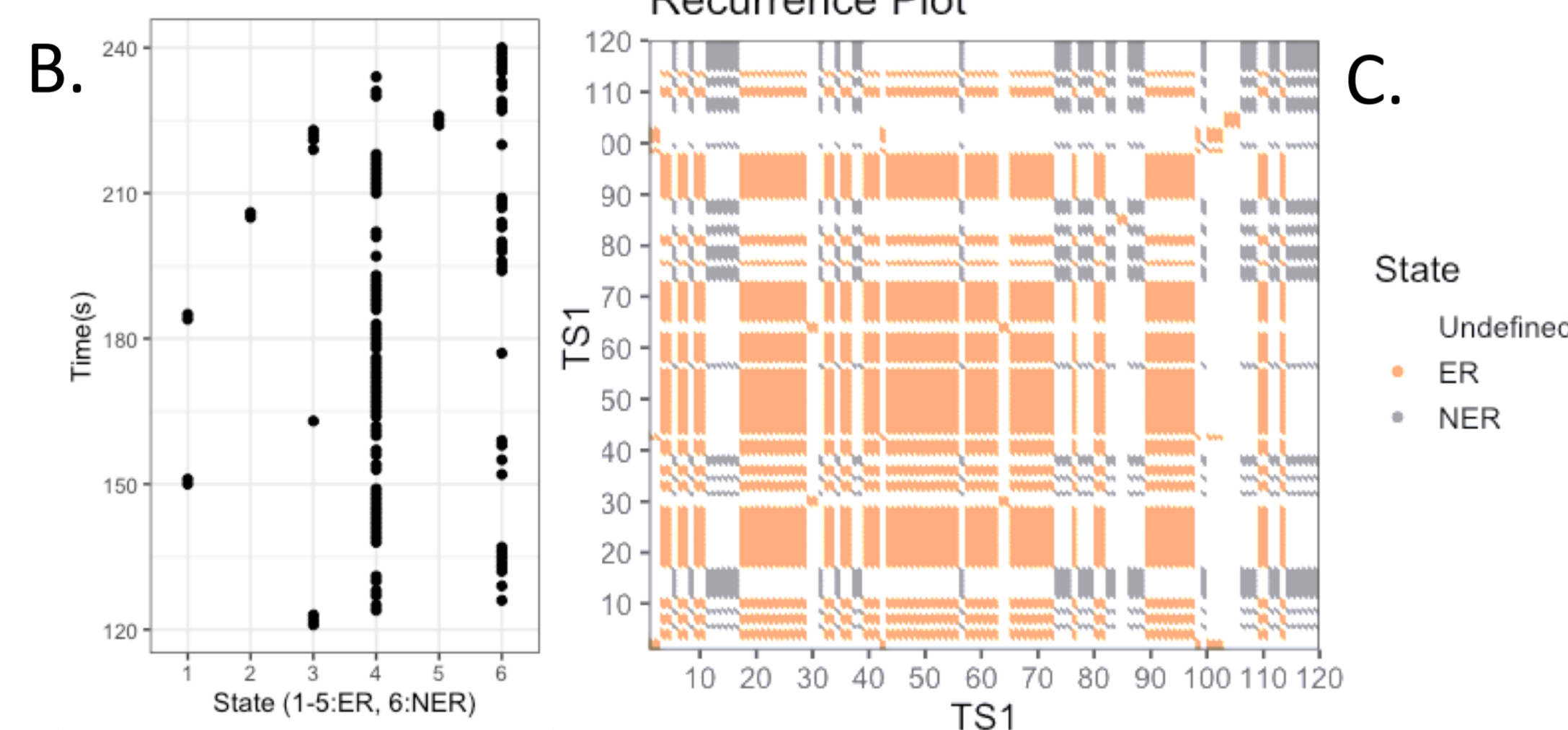
Sample: Term and Preterm infants (born at <33 weeks gestation age (GA)) recruited to Theirworld Edinburgh Cohort Study⁷

Inclusion criteria: Participated in still-face paradigm at 9-month follow-up (N=133)

Exclusion criteria: Did not complete at least 1 still-face episode (N=4) no video of still-face (N=1) or camera angle obstructed coding of infant behaviours (N=12)



2min	Play
2min	SF1
2min	Play
2min	SF2
2min	Play



A. Still-face paradigm to elicit stress in infant: Three play episodes with caregiver, alternating with two still-face (SF) episodes (SF1 and SF2) where caregiver stops interacting and ignores infant.

B. Second-by-second video-coding of states:

- ER : Common emotion regulation (ER) behaviours (categories: 1-self-soothing, 2-object distraction, 3-social-oriented, 4-repetitive movement, 5-escape)
- NER : Absence of ER behaviours (category 6)

C. Chromatic Recurrence Quantification Analysis (ChrRQA)⁸ to analyse dynamics of state changes by ER (orange) and NER (grey) states, i.e. quantifies features of a graphical plot of whether a state at time T previously occurred at earlier time points, or occurs at future time points.

D. 9-month measures of ER behavioural dynamics⁶

- **Recurrence rate (RR):** % of recurring ER states
- **Laminarity (LAM):** % of ER states recurring as part of a 2s or longer period
- **Trapping time (TT):** Average time an ER state persists for
- **Entropy (ENTb):** Information entropy of rectangular blocks i.e. how unlikely you will find similar blocks

E. 2-year autistic traits were measured using the Quantitative Checklist for Autism in Toddlers (Q-CHAT)

F. Statistical analyses

- (1) Linear Mixed-effects models for effect of preterm birth and still-face episode on each dynamic characteristic
- (2) Descriptive analyses
- (3) Linear regression models for effect of 9-month dynamic characteristic on 2-year autistic traits

RESEARCH QUESTIONS AND HYPOTHESES

RQ1. Are the dynamics of ER behaviours different between 9-month-old term and preterm infants?

Hypothesis: Infants born preterm will show lower complexity of dynamic patterns (indicated by lower entropy), disrupted dynamic stability (indicated by longer trapping time and a difference in laminarity of behavioural states)

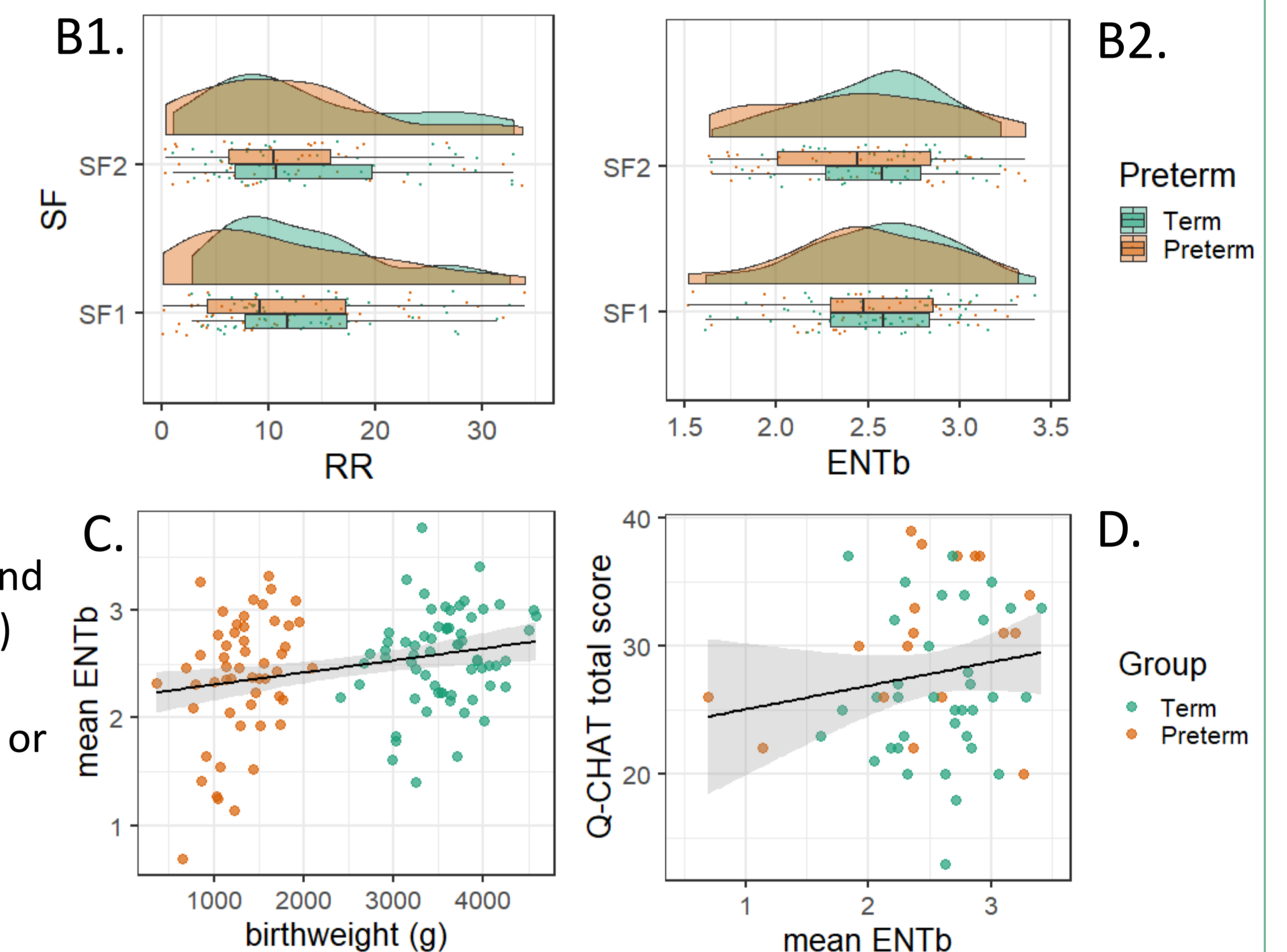
RQ2. What is the association between 9-month ER behavioural dynamics and autistic traits at 2-years?

Hypothesis: Lower entropy, and longer trapping time, are associated with greater autistic traits

RESULTS

A. Analysis sample (N=118)

	Total n	Male n (%)	Birthweight, g mean (sd)	GA mean (sd)
Term	65	(52%)	3454 (471)	39.4 (1.3)
Preterm	53	(60%)	1315 (370)	29.1 (1.9)



B. Linear mixed models (RQ1)

Evidence that infants born preterm show **lower:**

- **RR** (Effect=-4.15, CI: -7.98 to -0.34, p=0.033) and
 - **ENTb** (Effect= -0.15, CI:-0.31 to -0.00, p=0.047)
- No evidence of group differences in:
- **LAM** (Effect: -0.31, CI: -1.89 to -1.27, p=0.639) or
 - **TT** (Effect = 0.09, CI=-0.61 to -0.79, p=0.703)

No evidence of differences between SF1 and SF2 (effect of SF) in any outcome measure

C. Descriptive analyses.

Positive correlation of **birthweight** with:

- RR (r=0.21, p=0.03), and
- ENTb (r=0.26, p=0.004)

D. Linear regression models (RQ2). 62 infants (29 term, 35 preterm) followed-up at 2-years to date. No evidence of a relationship with 2-year Q-CHAT total score for:

- ENTb (1.84, CI: -1.34 – 5.02, p=0.250) or
- TT (0.26, CI: -0.98 – 1.50, p=0.677)

DISCUSSION AND CONCLUSIONS

RQ1: Differences in ER behavioural dynamics associated with prematurity relates to lower complexity (ENTb) but not measures relating to stability (TT and LAM)

→ Preterm brain injury and altered neural development potentially reduces behavioural complexity during social stress by impacting the coordination of neural systems for emotion regulation

RQ2: Insufficient power may explain why we did not find associations between ER behavioural dynamics at 9-months and autistic traits at 2-years.

→ Behavioural dynamics and autistic traits contain high within-group variation. Potential associations may be clarified when follow-up is complete

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INSAR, May 2021 | chua-yu-wei@strath.ac.uk

Acknowledgements: We are grateful to the infants and families who participated in Theirworld Edinburgh Birth Cohort Study, and sincerely thank Prof Ralf Cox for his time to discuss our application of Chromatic-RQA.