Freddie says hello!

UEL BabyDevLab

Current members - PhDs

LISS DTP London Interdisciplinary Social Science Doctoral Training Partnership

E·S·R·C ECONOMIC & SOCIAL RESEARCH COUNCIL

TÜBİTAK

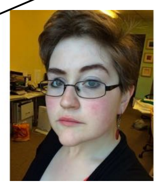
E·S·R·C ECONOMIC & SOCIAL RESEARCH COUNCIL

Endogenous attention, emotion reactivity and regulation

Environmental transmission of emotion dysregulation

Educational environment, attention and learning

Home stress and neural sensitivity



Interpsonal neural synchrony, endogenous attention, parental sensitivity

LEVERHULME TRUST

Default Mode and State Switching

Postdocs

Neural correlates of 'active' and 'passive' learning

Naturalistic stress and attention in Rett Syndrome

NHS National Institute for Health Research

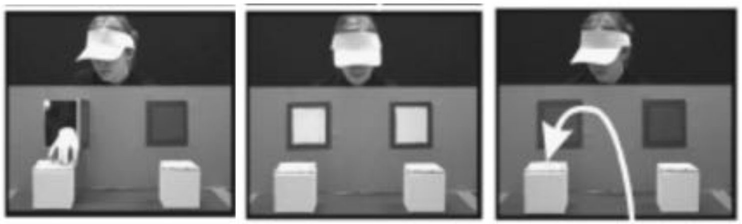
rett syndrome research trust

Horizon 2020 Programme

Interpersonal synchrony and responsivity during early life


“Contra Fodor, I argue that...”

Current approaches:



Current approaches:

- Non-interactive

Current approaches:

- Non-interactive

  Neural responses to the same social stimuli differ widely between interactive and non-interactive settings (Redcay & Warnell, 2018)

Current approaches:

One-way flow of information

Bi-directional information exchange

Even early learning is bi-directional – 'active learning' (Begus & Southgate, 2018)

Current approaches:

- *Massively* simplified

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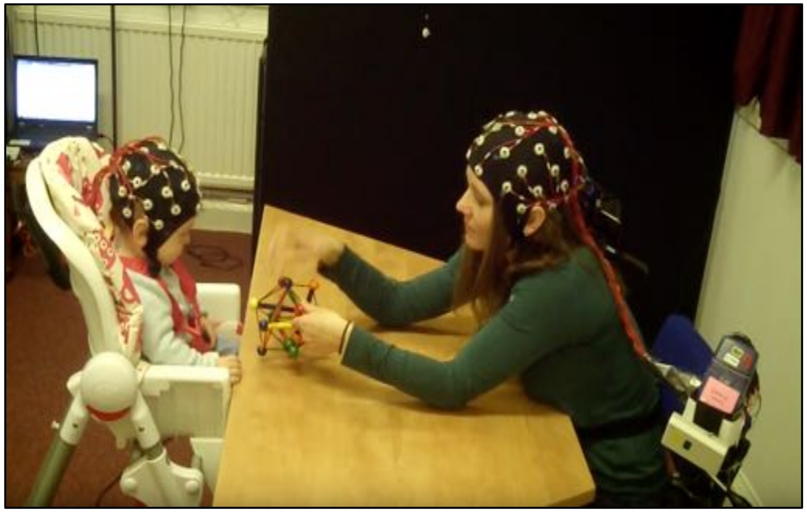
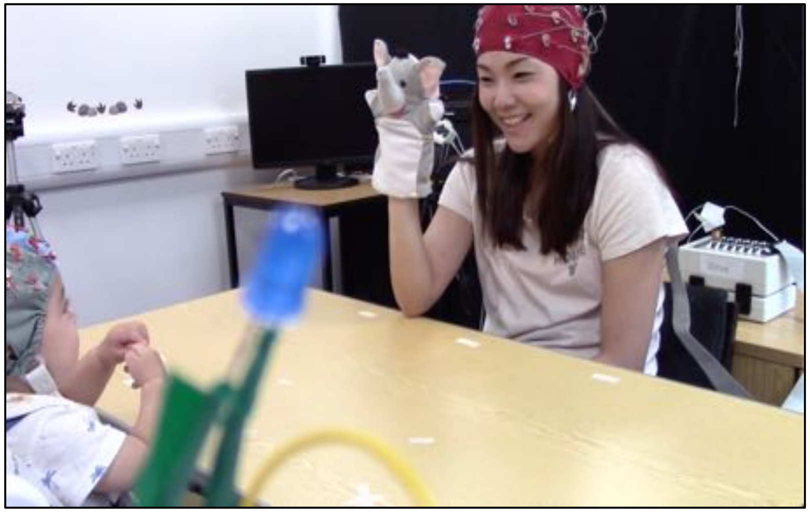
- *Massively* simplified

Naturalistic interactions
Giving as few instructions as possible...





Social influences on attention and learning are *transient and dynamic*:

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- When an 16-month-old infant initiates a learning exchange by pointing to an object, their memory retention for functions subsequently demonstrated on that object is increased (Begus, Gliga, & Southgate, 2014).

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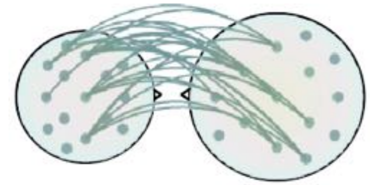
- When a parent pays attention to a particular object while they are engaged in shared activity with their 12-month-old infant, this immediately increases the duration of attention that the infant pays to that object (Yu & Smith, 2016).

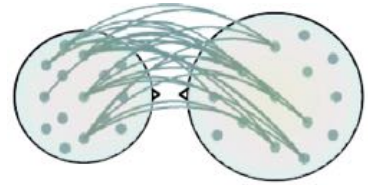
Neural synchrony
Take-away



- During social interaction, interpersonal neural phase synchrony transiently increases following mutual gaze and decreases during episodes of object play

Wass et al., under revision, *TICS*

Neural synchrony
Take-away



- During social interaction, interpersonal neural phase synchrony transiently increases following mutual gaze and decreases during episodes of object play

How?
Two completely different routes to neural phase synchrony:

- naturally occurring 'edges' in social interactions (such as gaze onsets) cause phase entrainment in both interacting brains
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Neural synchrony
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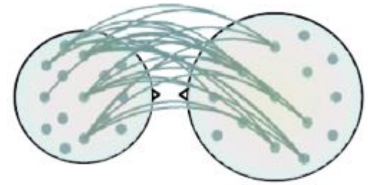

- End on the question:

  Are neural and physiological synchrony best seen just as epiphenomena of behavioural synchrony? Or do they play a distinct, mechanistic role in early attention, and learning?

Wass et al., under revision, *TICS*

Neural synchrony
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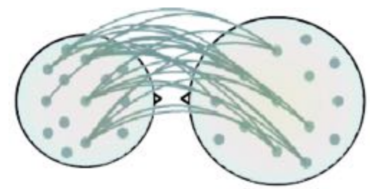

- End on the question:
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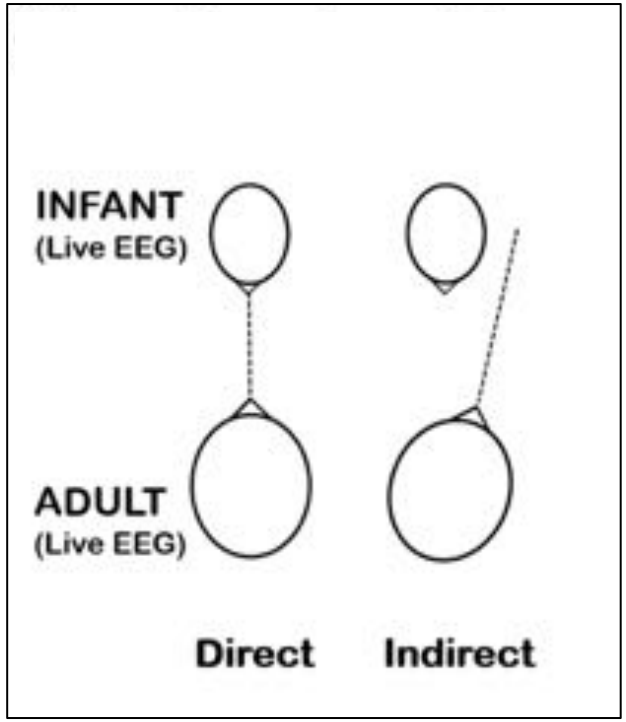
  The jury's still out!

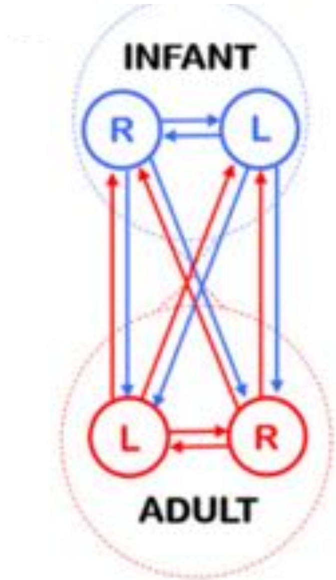
Wass et al., under revision, *TICS*

Leong, [...] & Wass, 2017, *PNAS*

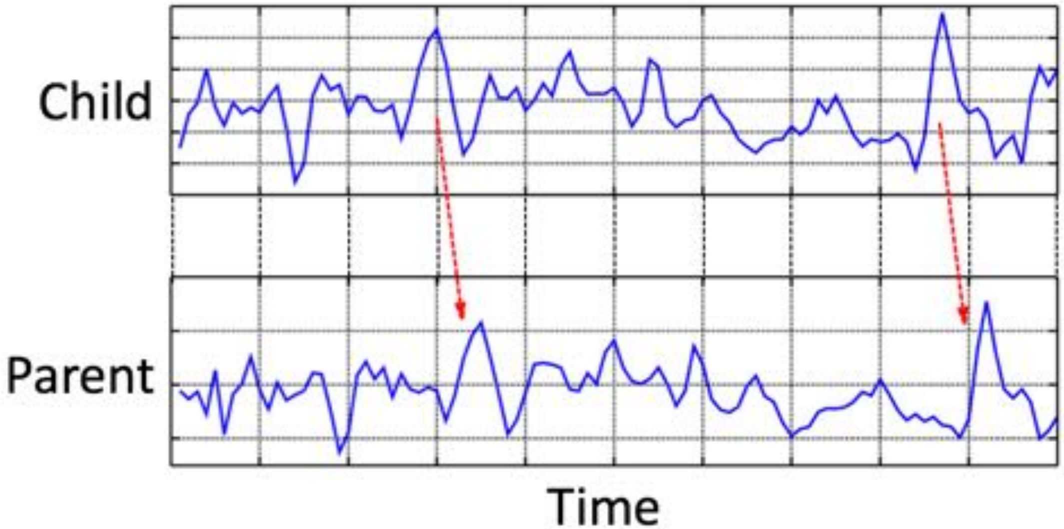


- Adult recited nursery rhymes

- Just looked at C3/C4 and 3-6 and 6-9Hz.

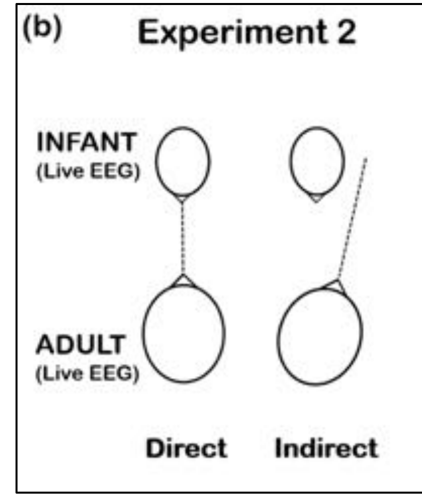


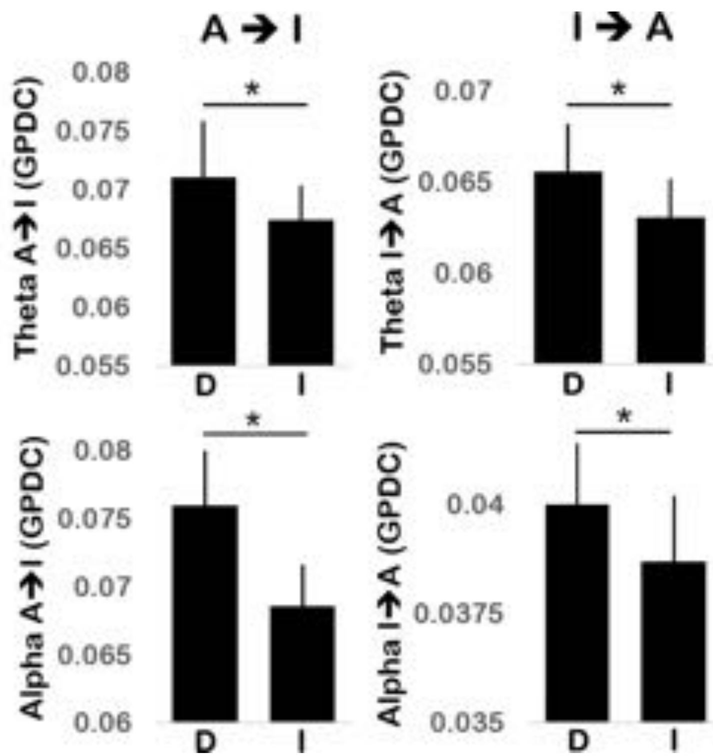
- Calculated Generalised Partial Directed Coherence to look at whether changes in the parent's brain activity anticipate changes in the child's brain activity, and *vice versa*...



During live interaction found both adult->infant AND infant->adult Granger-causal influences.

Both influences were stronger during direct gaze.

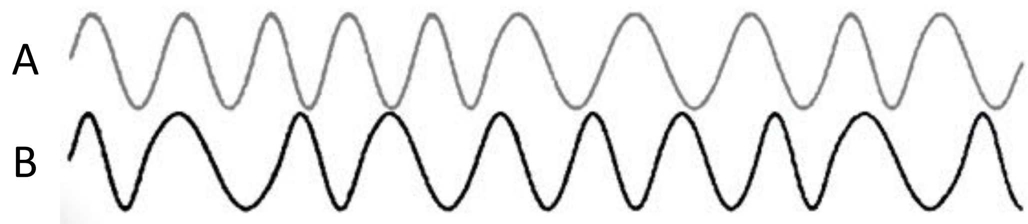


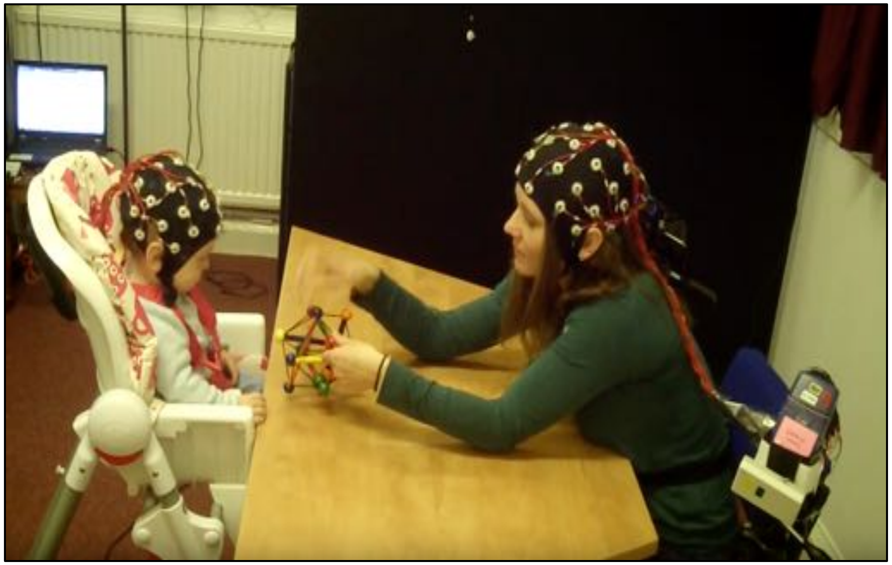


Free tabletop play

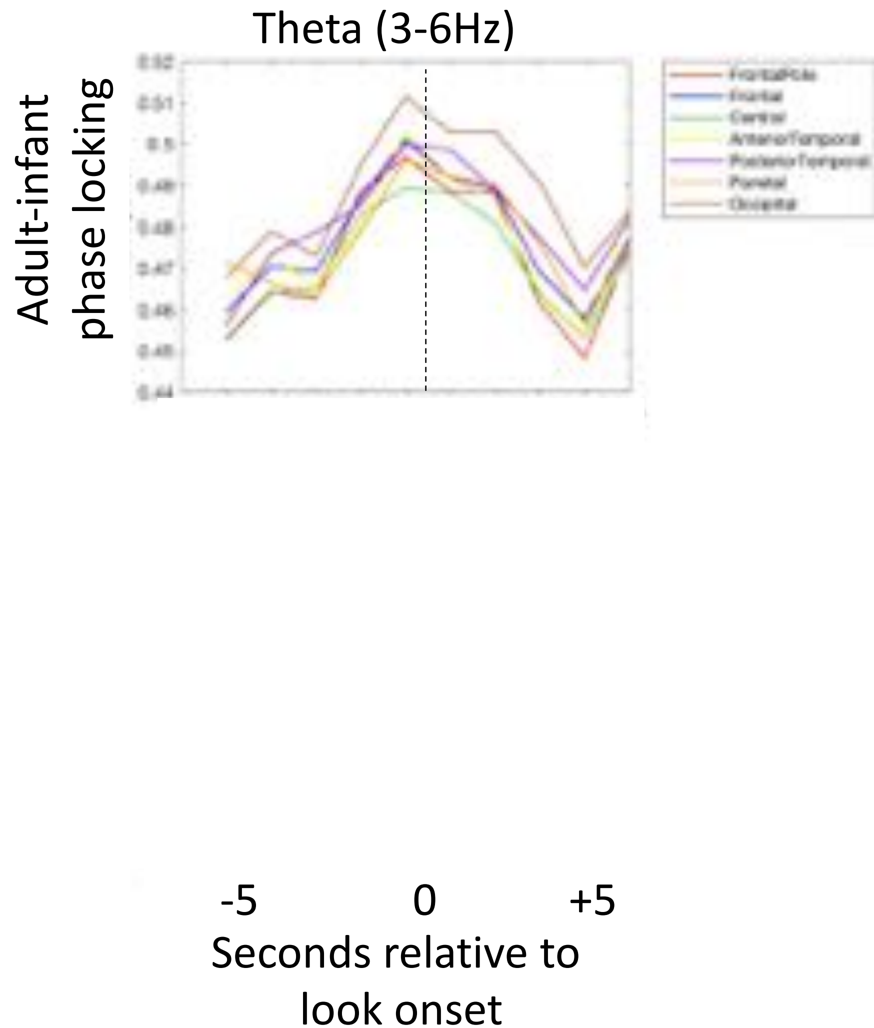
Phase-Locking Value

1-16Hz.

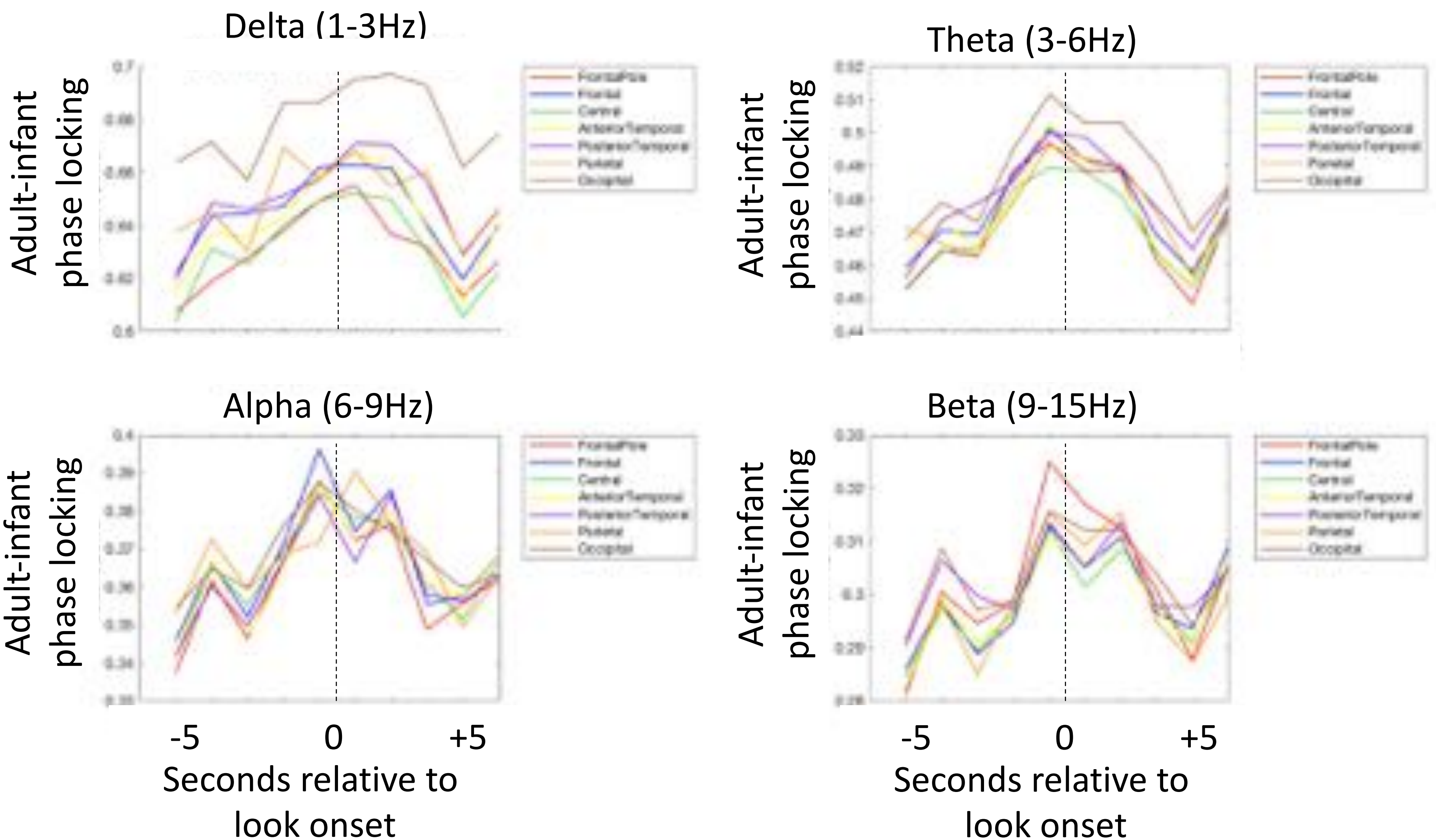




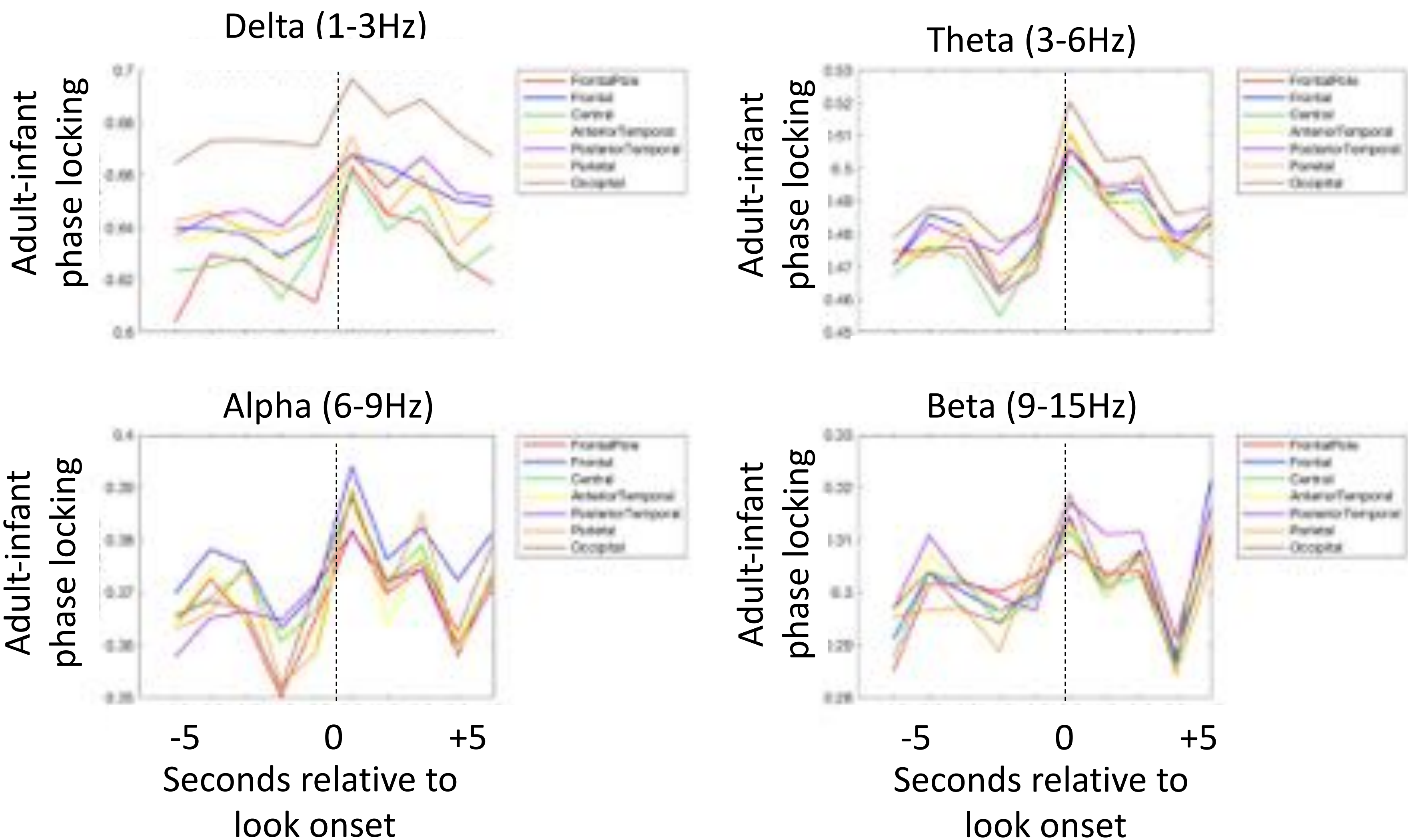
Phase-locking increases around mutual gaze onsets – whether it’s the parent joining the look...



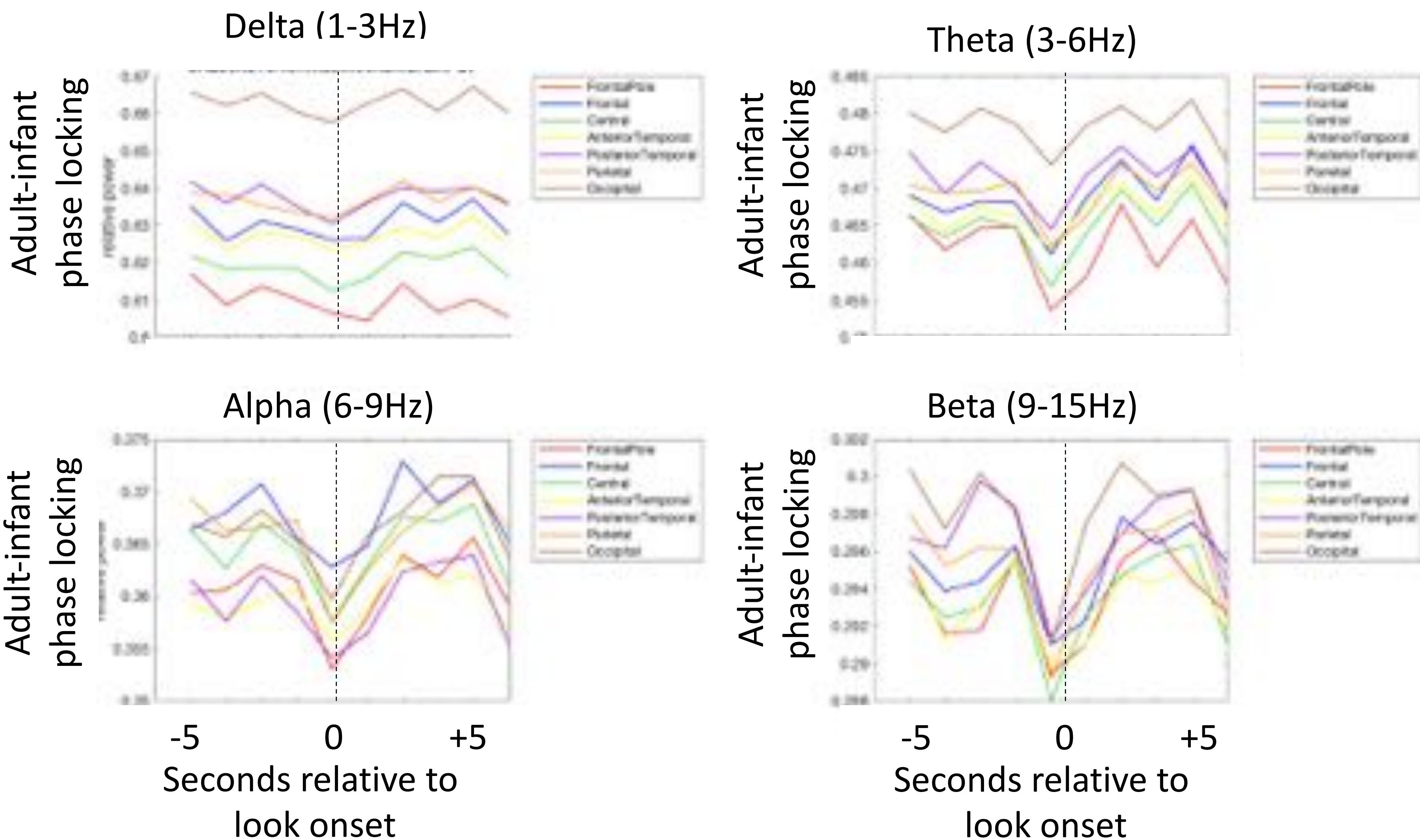
Phase-locking increases around mutual gaze onsets – for parent-initiated mutual gaze



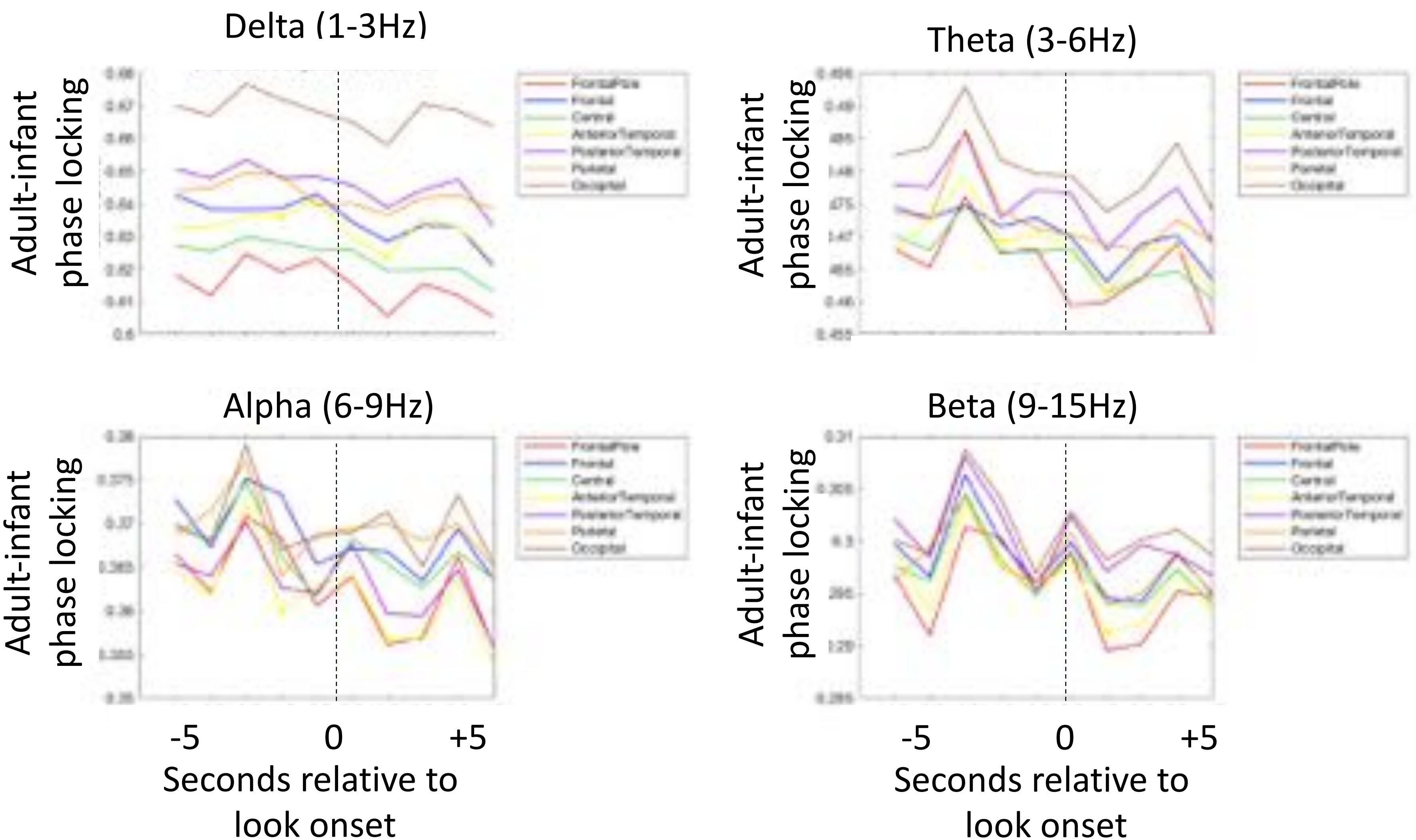
...and for infant-initiated mutual gaze



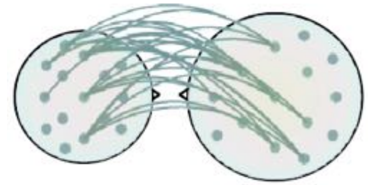
Phase locking increases following non-reciprocated parent looks to infant



...whereas looks to objects lead to decreases in phase synchrony...



Neural synchrony
Take-away



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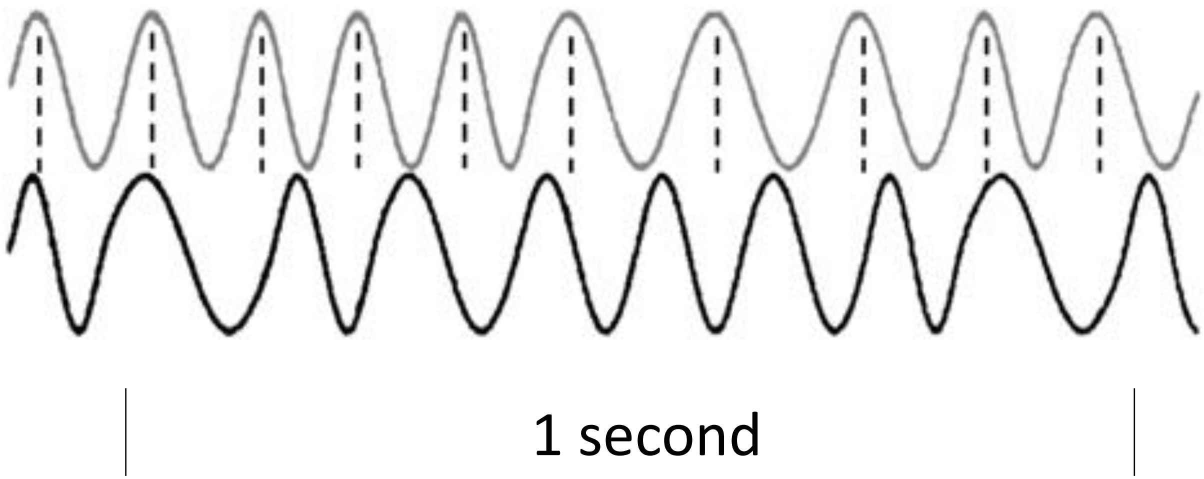
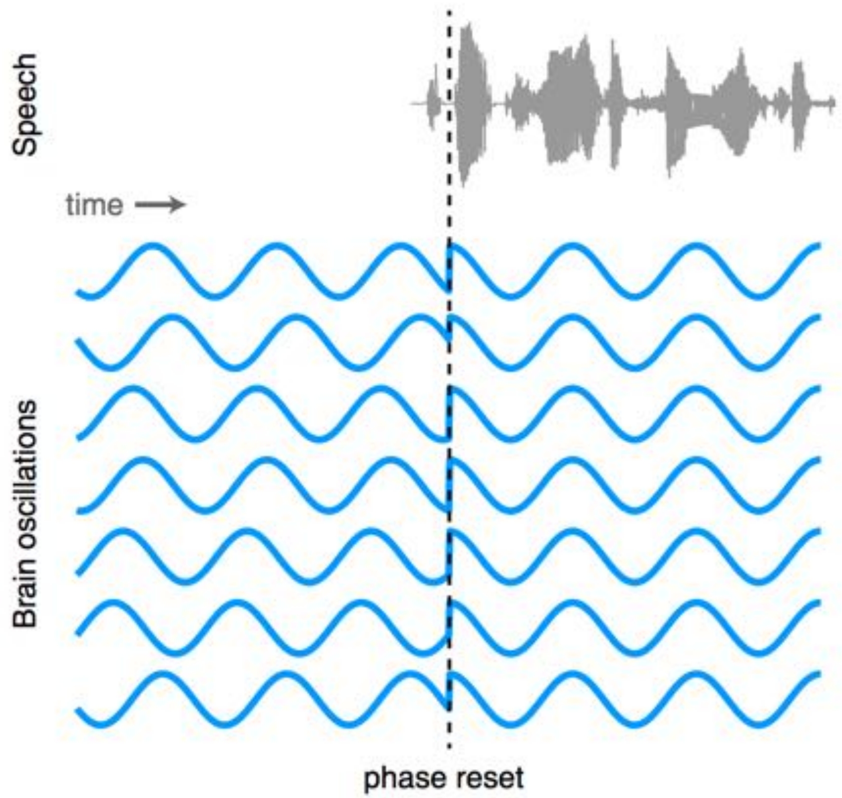
Wass et al., under revision, *TICS*

How is phase entrainment (at up to 9Hz!!) achieved?



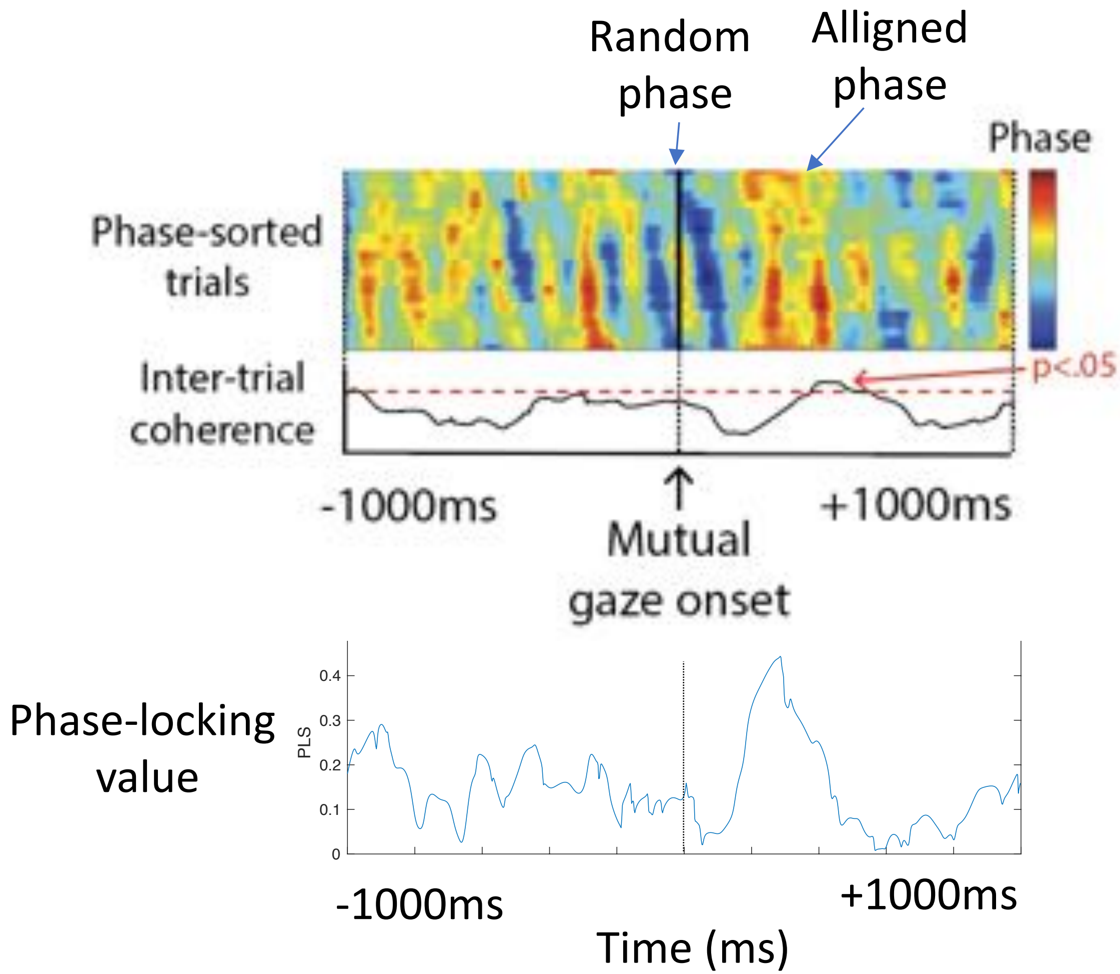
How is phase entrainment (at up to 9Hz!!) achieved?

Speech-brain entrainment: acoustic ‘edges’ (i.e. sharp increases in signal intensity) in the speech amplitude envelope that drive theta- and delta-rate EEG oscillations to entrain to the rhythms in natural speech (Doelling, Arnal, Ghitza, & Poeppel, 2014)



How is phase entrainment (at up to 9Hz!!) achieved?

Do gaze onsets act as 'edges' in the same way – causing phase-resetting in two brains concurrently during social interaction?



How is phase entrainment (at up to 9Hz!!) achieved?

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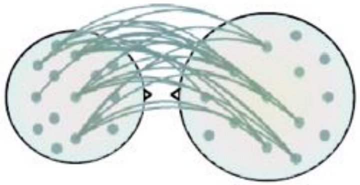
Might also be true for vocalisations, touch...

Neural synchrony
Take-away



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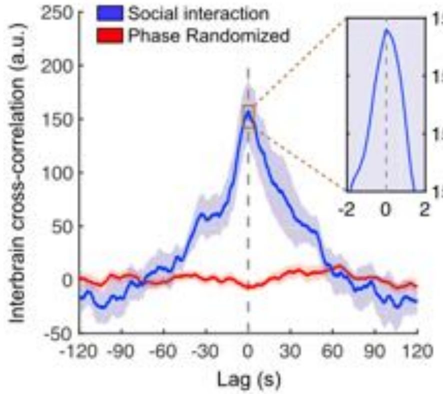

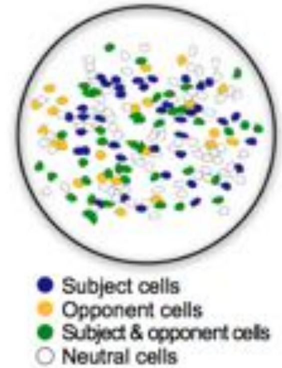

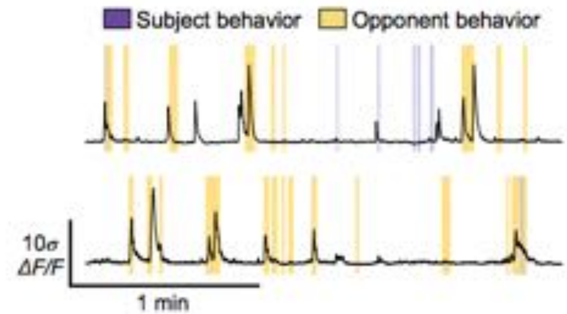

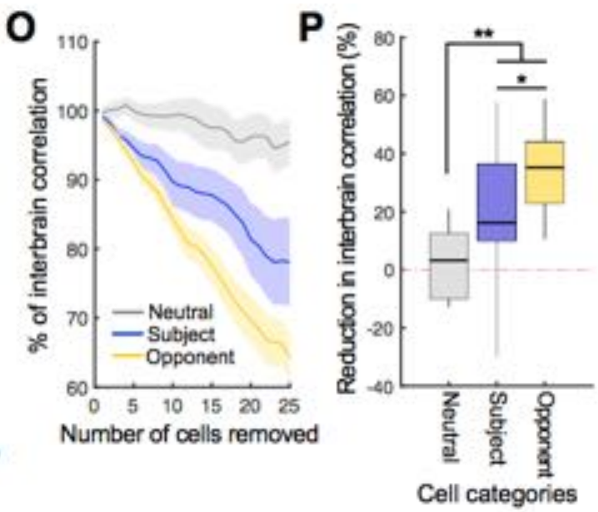

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Article

Cell

Correlated Neural Activity and Encoding of Behavior across Brains of Socially Interacting Animals

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[1]Department of Biological Chemistry and Department of Neurobiology, David Geffen School of Medicine, University of California, Los Angeles, Los Angeles, CA 90095, USA
[2]Department of Neurology and Department of Psychiatry & Biobehavioral Sciences, David Geffen School of Medicine, University of California, Los Angeles, Los Angeles, CA 90095, USA
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SUMMARY

Social interactions involve complex decision-making tasks that are shaped by dynamic, mutual feedback between participants. An open question is whether and how emergent properties may arise across brains of socially interacting individuals to influence social decisions. By simultaneously performing microendoscopic calcium imaging in pairs of socially interacting mice, we find that animals exhibit interbrain correlations of neural activity in the prefrontal cortex that are dependent on ongoing social interaction. Activity synchrony arises from two neuronal populations that separately encode one's own behaviors and those of the social partner. Strikingly, interbrain correlations predict future social interactions, as well as dominance relationships in a

picture that reflects the dynamic nature of social interactions, as well as the emergent neural properties that arise from multiple individuals as a single integrated system (Adolphs, 2010; Chen and Hong, 2018; Ochsner and Lieberman, 2001; Schilbach et al., 2013).

In recent years, much effort has been made to explore how neural systems coordinate across individuals engaged in social interaction. Simultaneous recordings from multiple human subjects using non-invasive techniques (e.g., functional MRI [fMRI] and electroencephalography [EEG]) have revealed striking patterns of interbrain neural activity coupling during social engagement (Babiloni et al., 2006; King-Casas et al., 2005; Liu and Pelowski, 2014; Montague et al., 2002). Despite these remarkable findings, little is concretely known about how interbrain synchrony arises from social interactions. Moreover, it remains unclear how synchrony emerges from individual neurons and neuronal populations, in part due to the limited spatial resolution of recording techniques in humans, which cannot resolve single-

Simony et al., 2016

- Synchrony in default mode network areas was higher during comprehensible vs incomprehensible video clips

nature COMMUNICATIONS

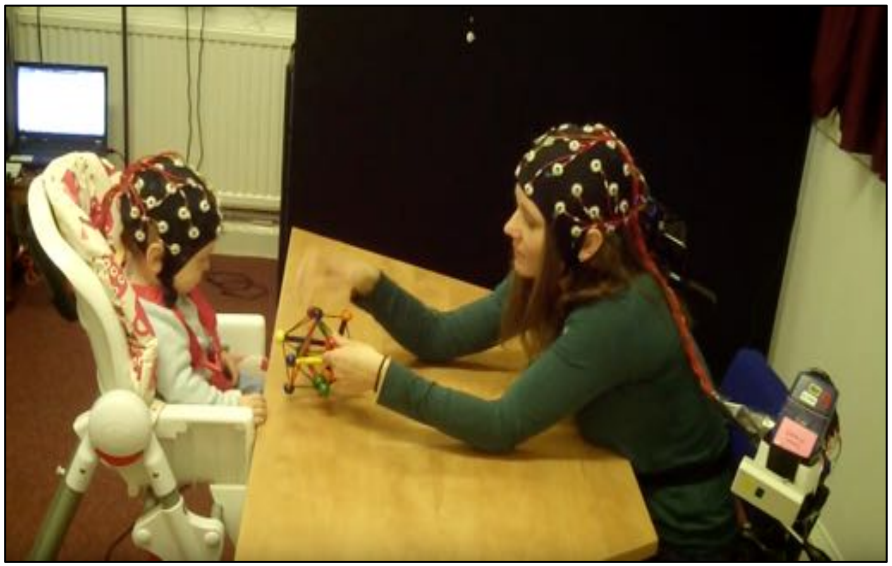
ARTICLE

Received 29 May 2015 | Accepted 6 Jun 2016 | Published 18 Jul 2016 DOI: 10.1038/ncomms12141 OPEN

Dynamic reconfiguration of the default mode network during narrative comprehension

Erez Simony[1,2], Christopher J. Honey[3], Janice Chen[1,2], Olga Lositsky[2], Yaara Yeshurun[1], Ami Wiesel[4] & Uri Hasson[1,2]

Does the default mode network (DMN) reconfigure to encode information about the changing environment? This question has proven difficult, because patterns of functional connectivity reflect a mixture of stimulus-induced neural processes, intrinsic neural processes and non-neuronal noise. Here we introduce inter-subject functional correlation (ISFC), which isolates stimulus-dependent inter-regional correlations between brains exposed to the same stimulus. During fMRI, we had subjects listen to a real-life auditory narrative and to temporally scrambled versions of the narrative. We used ISFC to isolate correlation patterns within the DMN that were locked to the processing of each narrative segment and specific to its meaning within the narrative context. The momentary configurations of DMN ISFC were highly replicable across groups. Moreover, DMN coupling strength predicted memory of narrative segments. Thus, ISFC opens new avenues for linking brain network dynamics to stimulus features and behaviour.



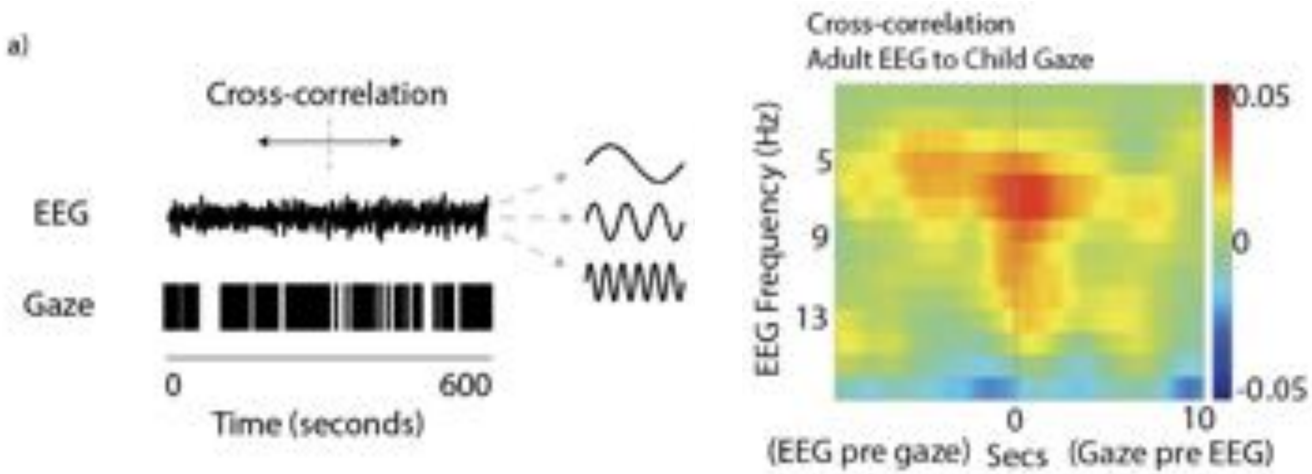
Child brain

Adult brain

Child behaviour

Adult behaviour

Adult brain dynamically tracks and responds to infant attention



Wass et al., under revision, *TICS*

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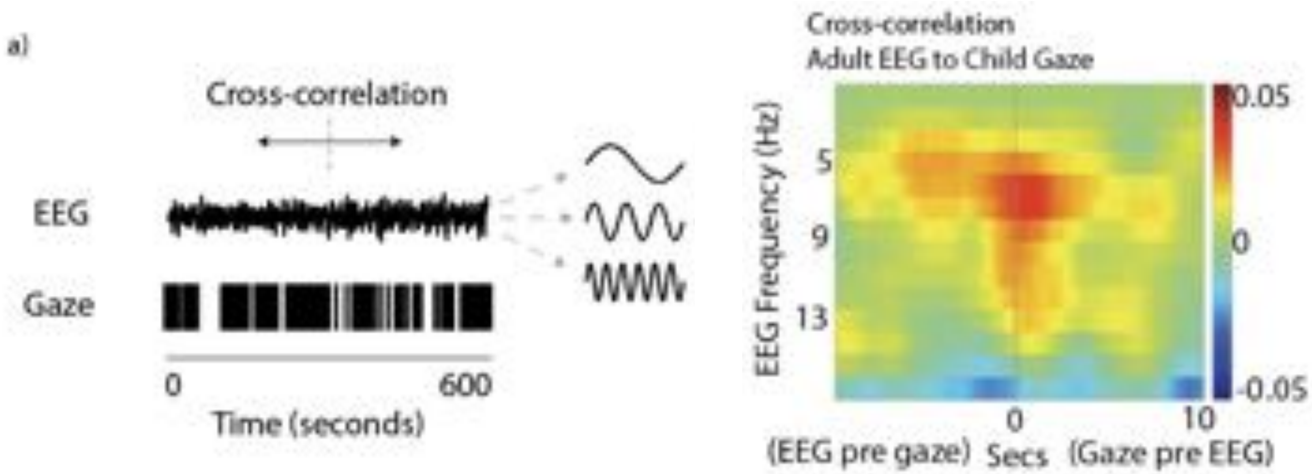

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Receptivity is higher for stimuli presented at high excitability oscillatory phases compared to inhibitory oscillatory phases are better remembered (Busch et al., 2009).

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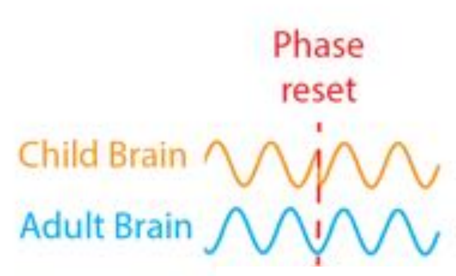
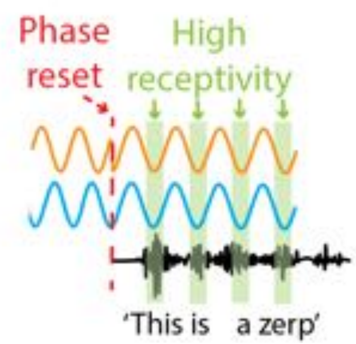
Receptivity is higher for stimuli presented at high excitability oscillatory phases compared to inhibitory oscillatory phases are better remembered (Busch et al., 2009).

Maybe phase synchrony during social interactions allows us to judge when to deliver learning items so that they are an optimal stage for the learners encoding.





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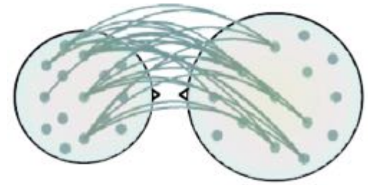
The jury’s still out on this one!

Neural synchrony
Take-away



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Wass et al., under revision, *TICS*

Neural synchrony
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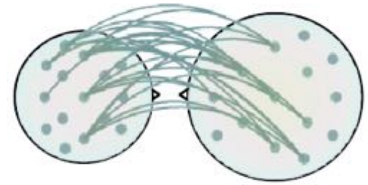

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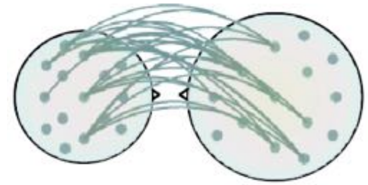

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Wass et al., under revision, *TICS*

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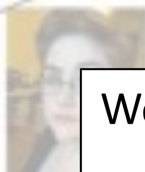

...terpsonal neural synchrony, ...ogenous attention, ...rental sensitivity

We're hiring!

1 postdoc starting early 2020

3 PhD positions starting Sept 2020

European Research Council

Established by the European Commission

Postdocs

Default Mode and State Switching

Neural correlates of 'active' and 'passive' learning

Naturalistic stress and attention in Rett Syndrome

National Institute for Health Research

rett syndrome research trust

Horizon 2020 Programme

THANK YOU!!

Twitter: @drsamwass
Email: s.v.wass@uel.ac.uk

LEVERHULME TRUST

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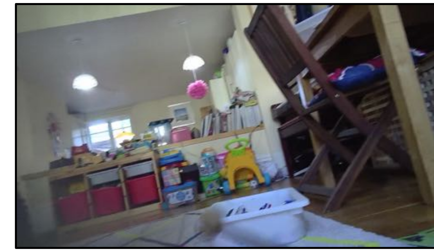
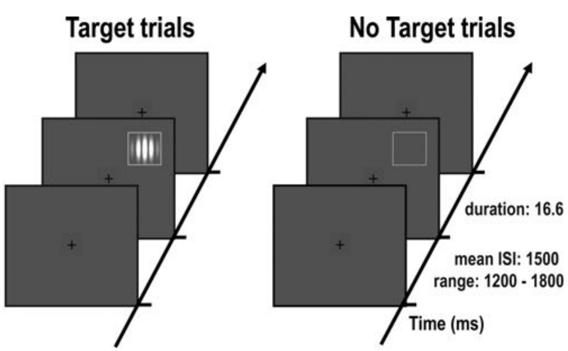
No man (or woman) is an island, entire to themselves...



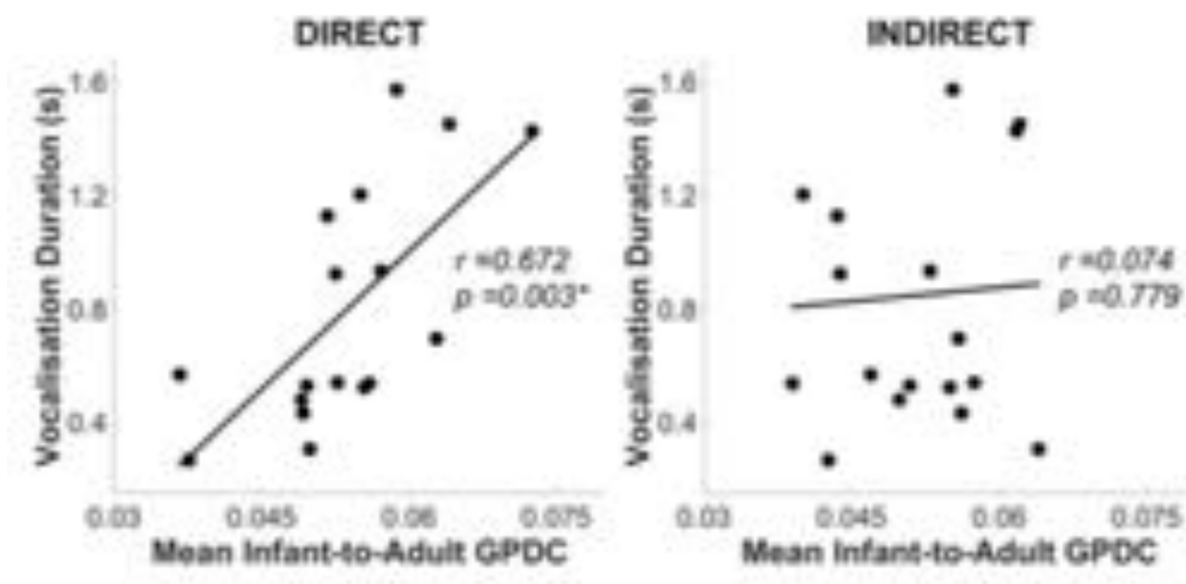
Phonological loop

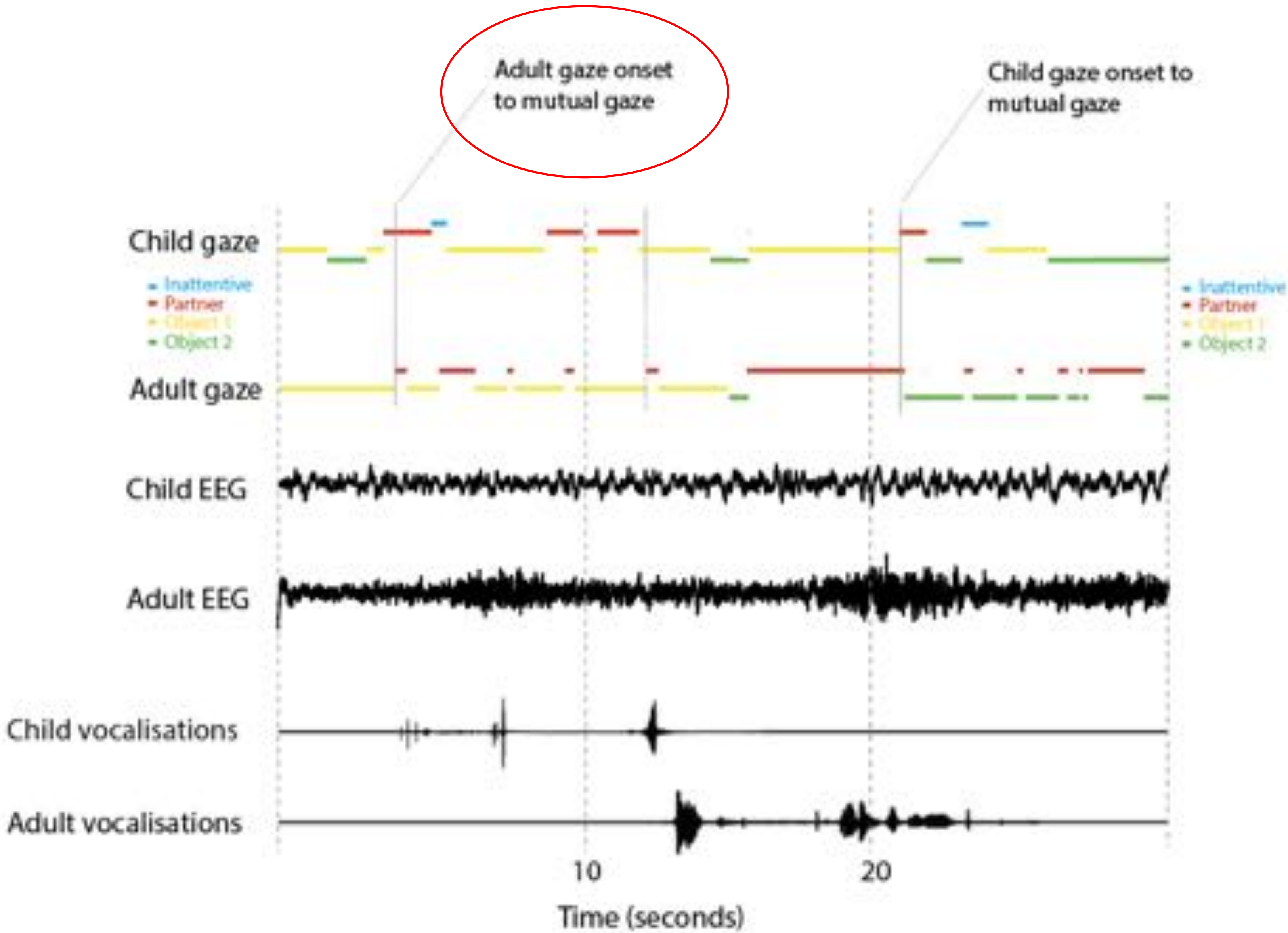
Visuospatial sketchpad

Central executive

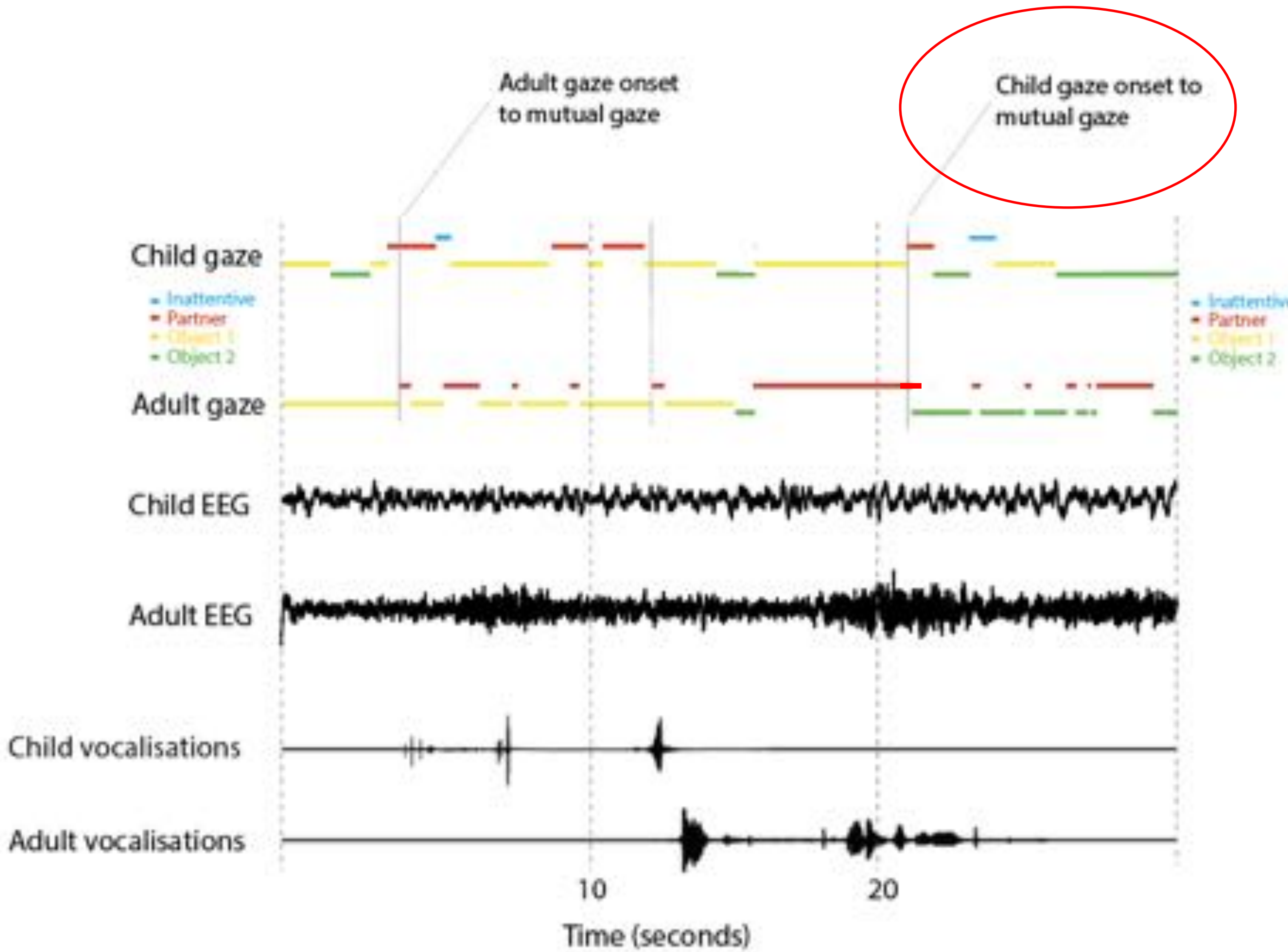


We also found that infants who vocalised for longer had a stronger influence on adult brain activity



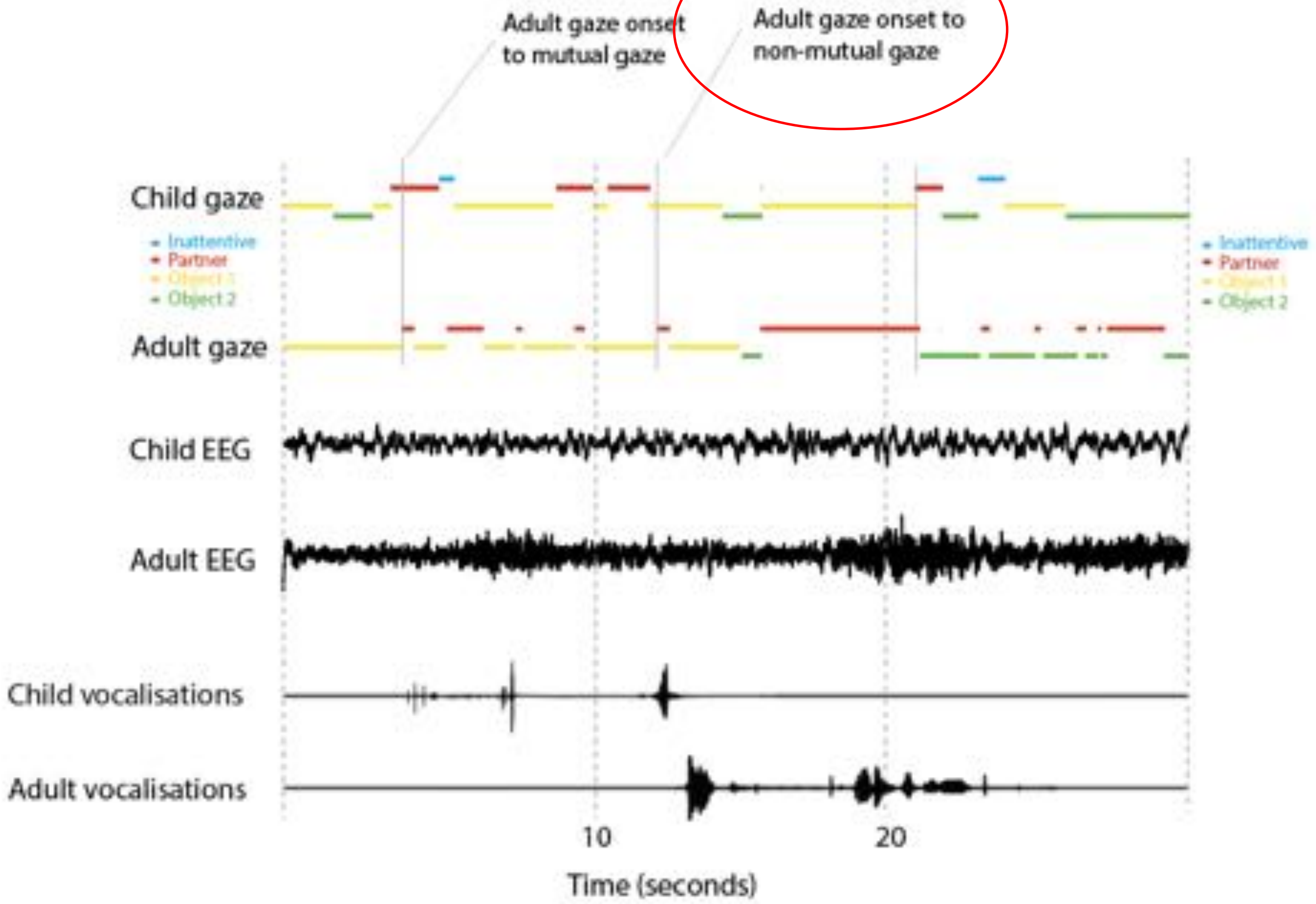


Wass et al., in prep



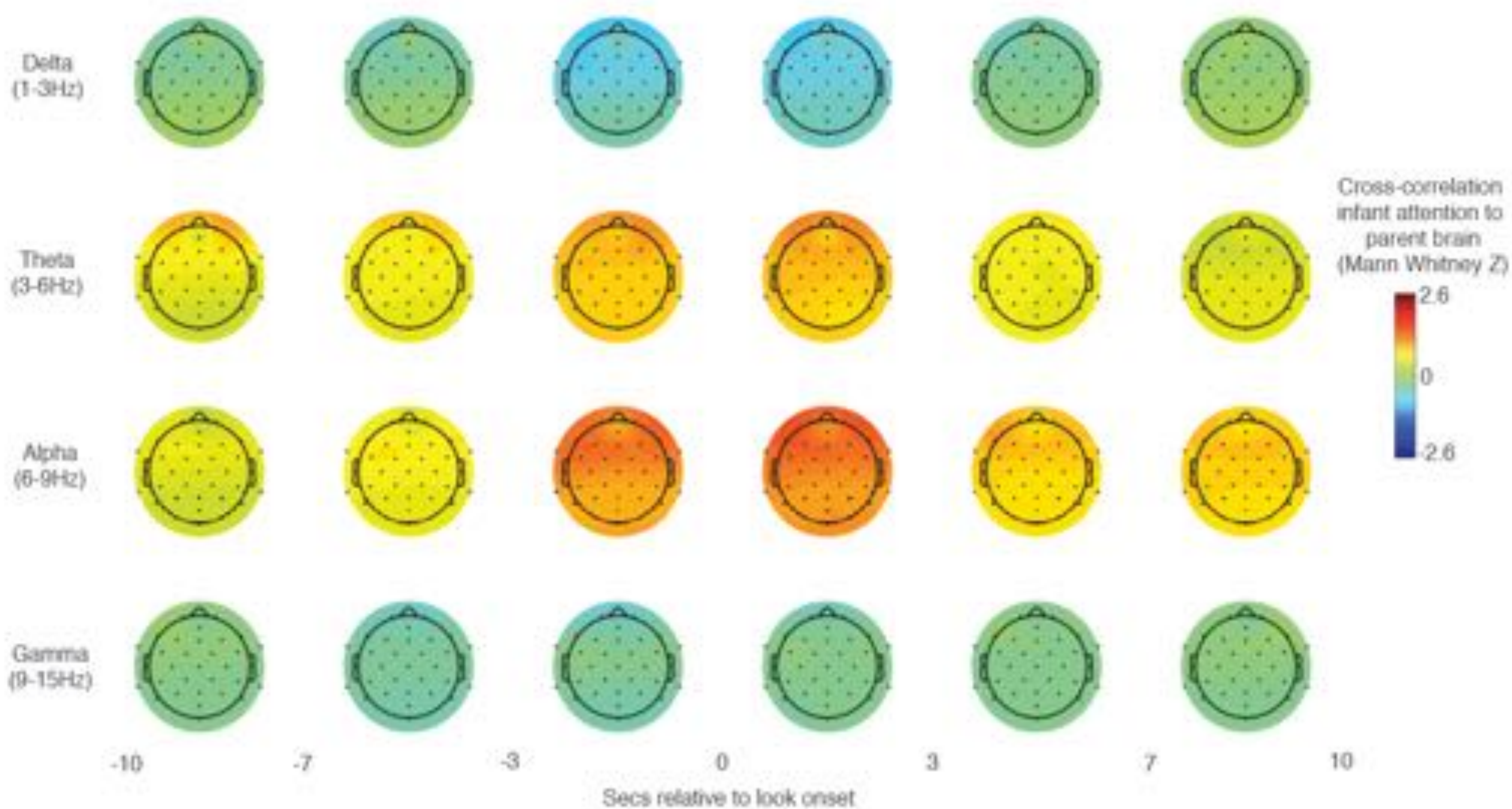
Wass et al., in prep

We can also look at gaze onsets to non-mutual gaze...



Parental frontal brain activity tracks and predicts infant attention during shared play

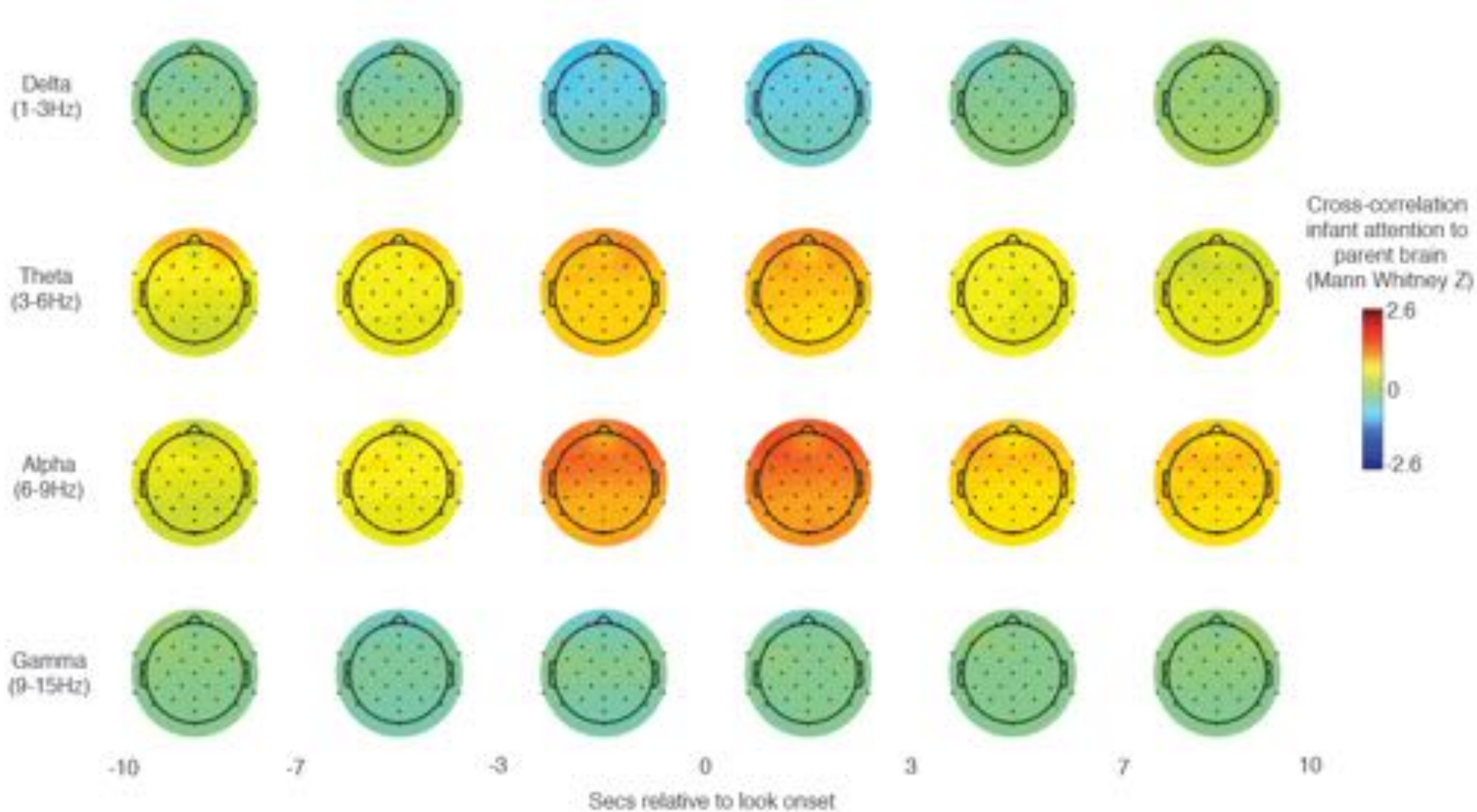
...Parise & Csibra, 2013



Wass et al., in prep

Parental frontal brain activity tracks and predicts infant attention during shared play

During joint play, the adult responds to the actions of the child by matching their own neural state to that of the child



Wass et al., in prep

People interested in social interaction should actually study social interaction?