Beat Tracking in Individuals with Williams syndrome

Sound Health Network Journal Club

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Vanderbilt University

Thank you to…

Dr. Miriam Lense

Dr. Reyna Gordon

Funding

NSF GRFP NSF GRADUATE RESEARCH FELLOWSHIP PROGRAM

NIH DIRECTOR'S NEW INNOVATOR AWARD

VANDERBILT KENNEDY CENTER

Biological Psychiatry: CNNI

Archival Report

Neurophysiological Correlates of Dynamic Beat Tracking in Individuals With Williams Syndrome

Anna Kasdan, Reyna L. Gordon, and Miriam D. Lense

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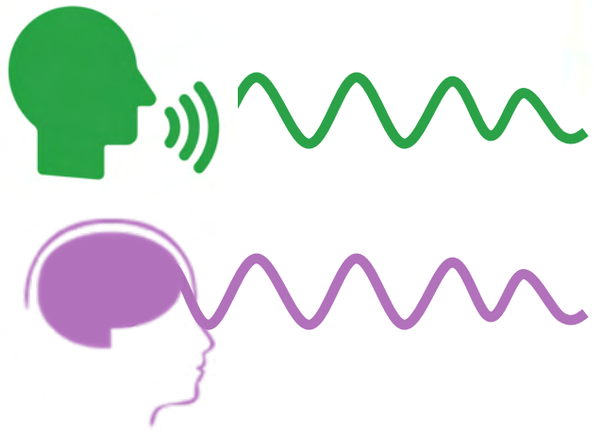
Musical rhythm

Rhythm: *Pattern of durations of musical notes or events*

Beat: *Regular pulse through which rhythm is perceived*

Dynamic attending theory

Internal neural oscillators become coupled to the temporal regularities of rhythms in our environment, optimizing attention to expected points in time (Jones & Boltz, 1989; Large & Jones, 1999).



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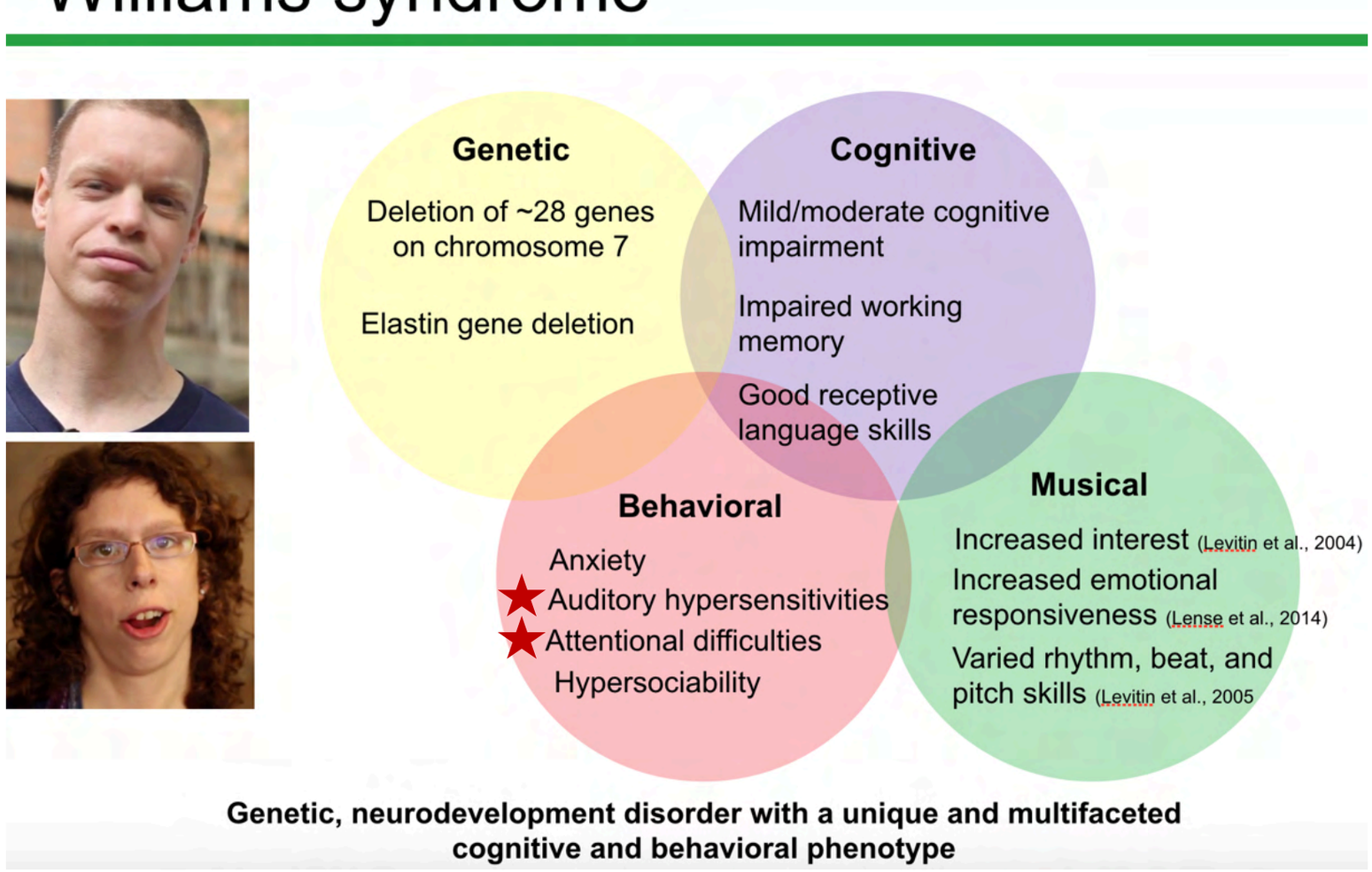

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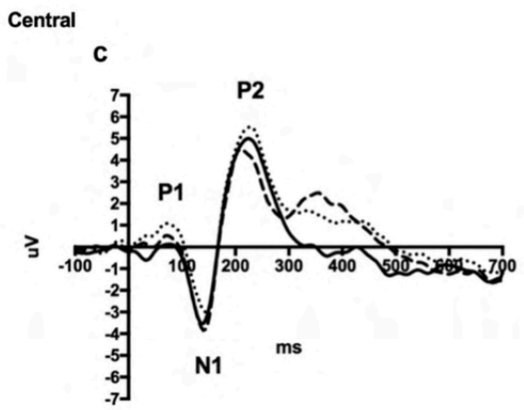
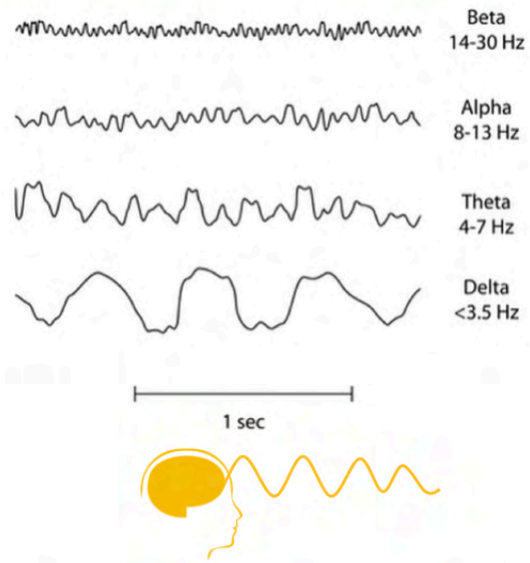
EEG analyses

Event-related potentials (ERPs)



Average, time-locked waveform

Time-Frequency



Dynamic frequency information

Jacobs et al., 2018. *Brain and Cognition*

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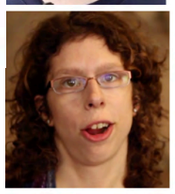
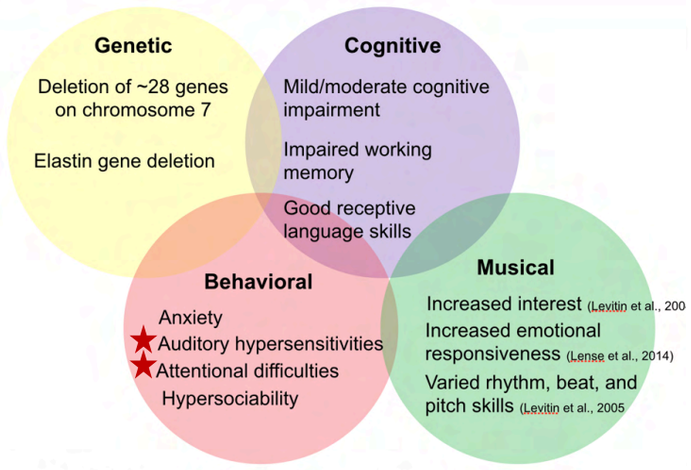
Williams syndrome

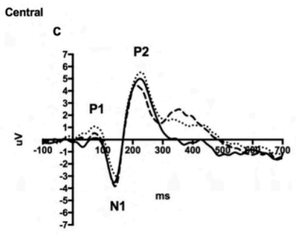




Genetic, neurodevelopment disorder with a unique and multifaceted cognitive and behavioral phenotype

EEG analyses

Event-related potentials (ERPs)



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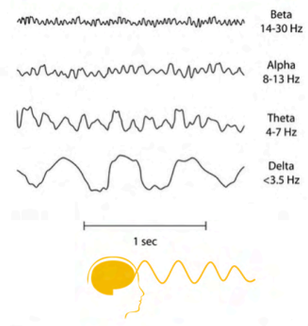


Dynamic frequency information

Jacobs et al., 2018. *Brain and Cognition*

Why rhythm in Williams syndrome?

1 A **strength based approach**: Individuals with WS are relatively good at music which makes it a good tool for research studies and understanding other cognitive functions.

2 Rhythm is a cue for **social communication**, and WS individuals with higher beat perception abilities have higher socialization skills (Lense & Dykens, 2016)

Aim: Assess the neural correlates of beat perception in WS.

Task and participants

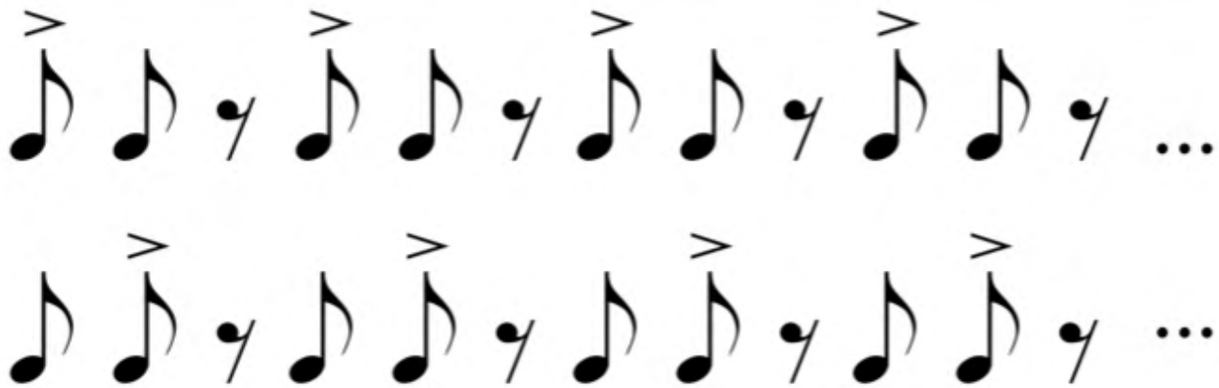
Passive beat perception

Accent1 Condition

Physical accent on 1st tone

Accent2 Condition

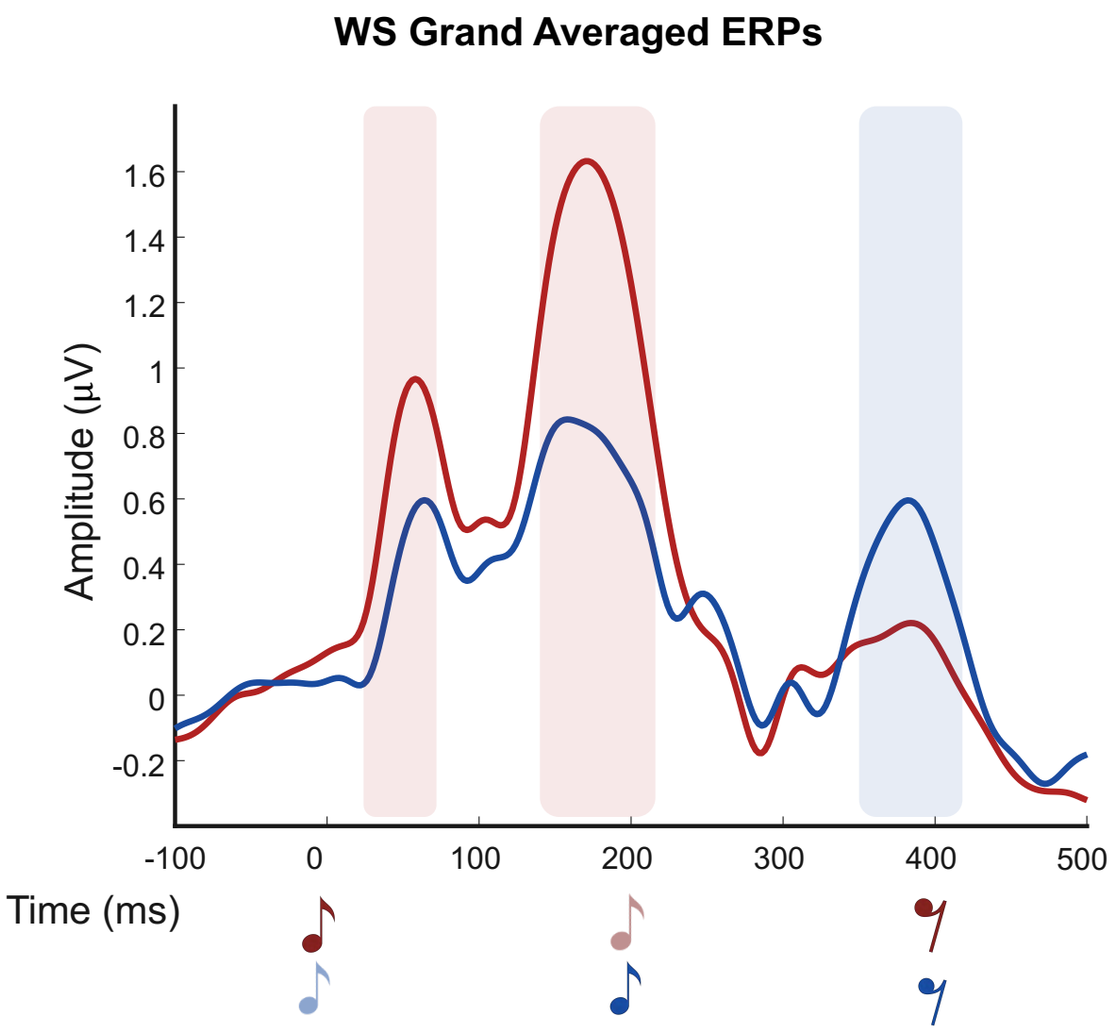
Physical accent on 2nd tone

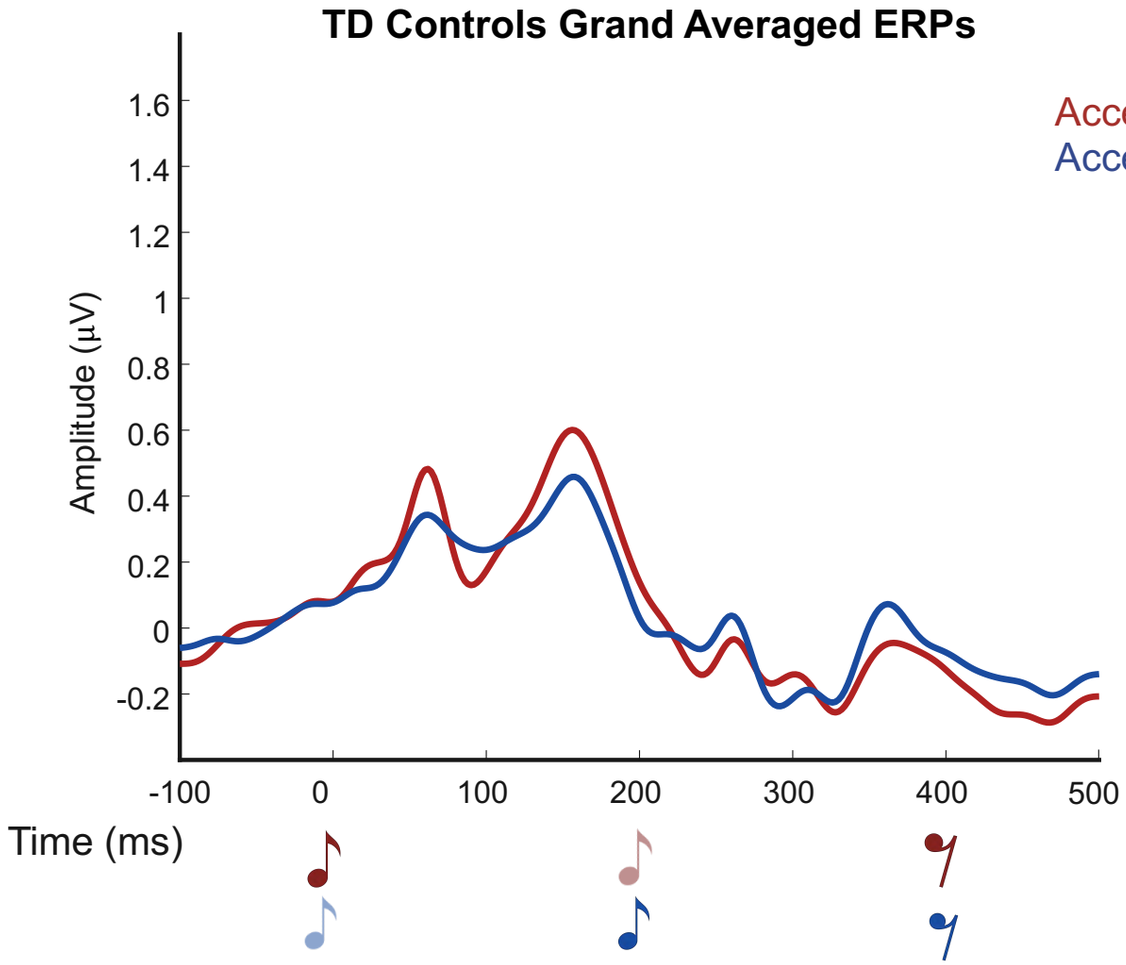


27 adults with Williams syndrome
16 typically developing controls

Iversen et al., 2009. *Ann. NY Acad Sci.*

Individuals with WS exhibit increased amplitude of auditory ERPs





Kasdan, Gordon, & Lense. *Biol Psych:CNNI. 2020.*

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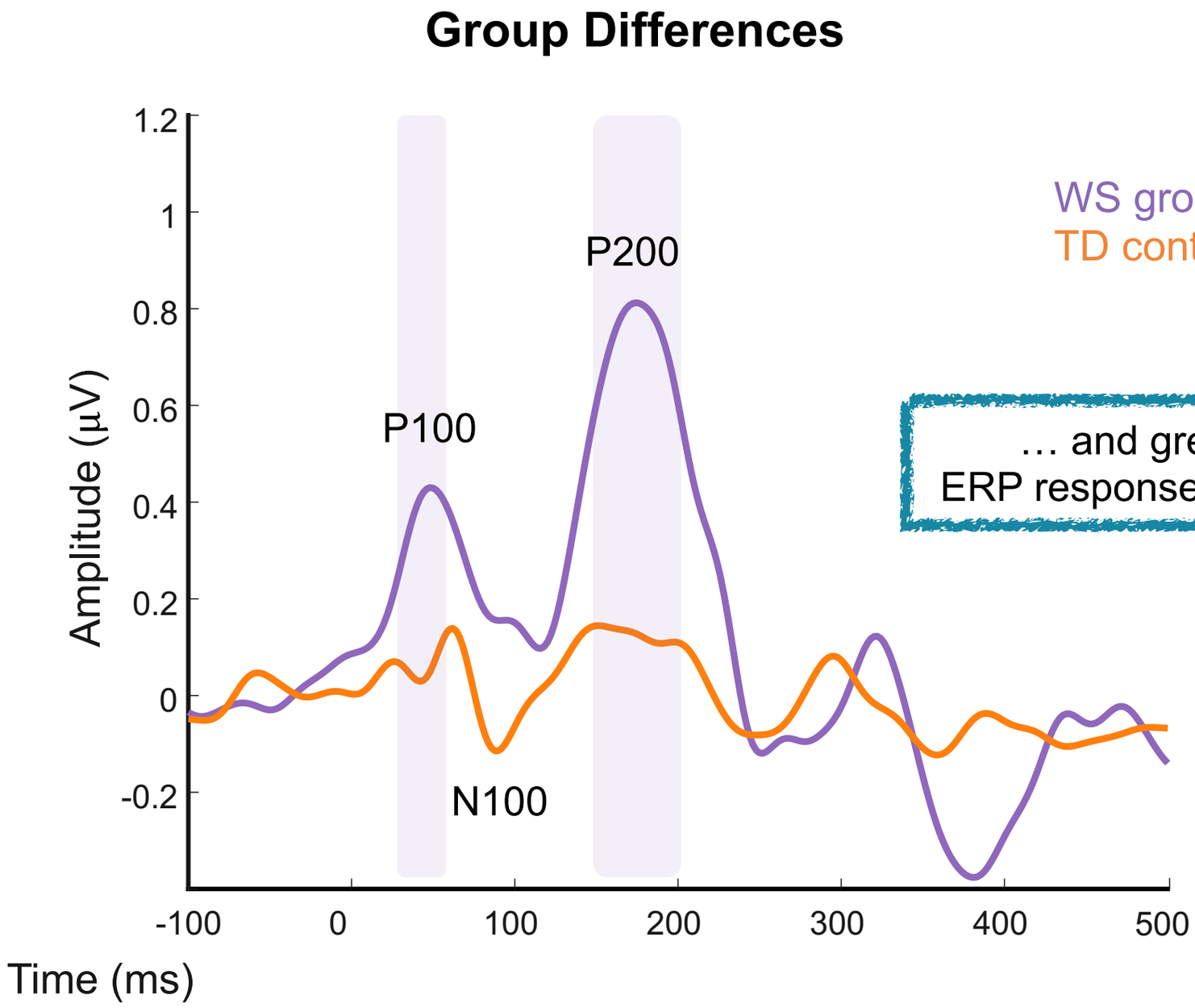


… and greater *stability* of auditory ERP responses throughout the experiment

Kasdan, Gordon, & Lense. *Biol Psych:CNNI. 2020.*

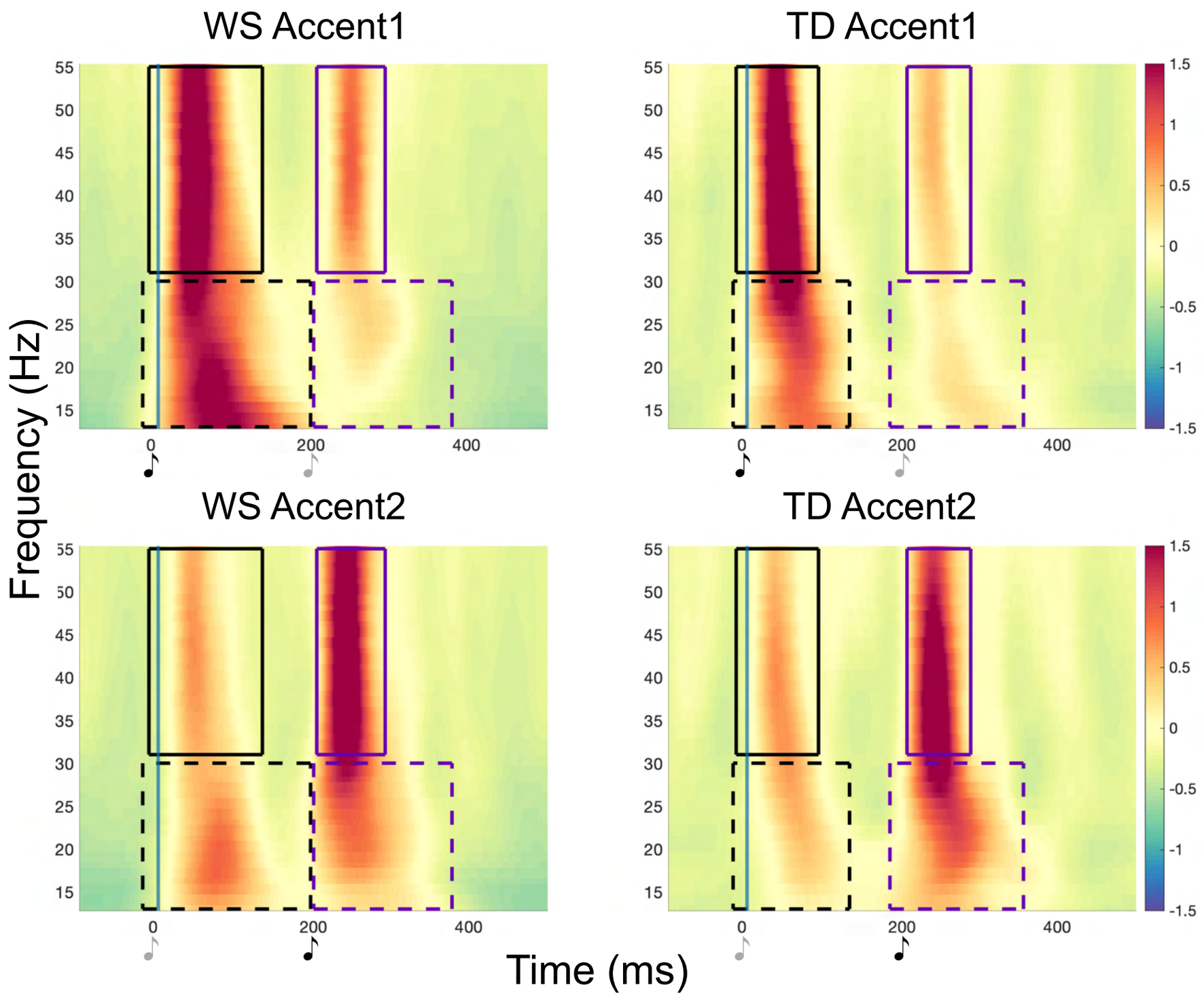
Both groups show canonical beta and gamma activity for beat perception

Gamma: 31-55Hz

Sensory processing
Rhythmic expectancy

Beta: 13-30 Hz

Beat perception



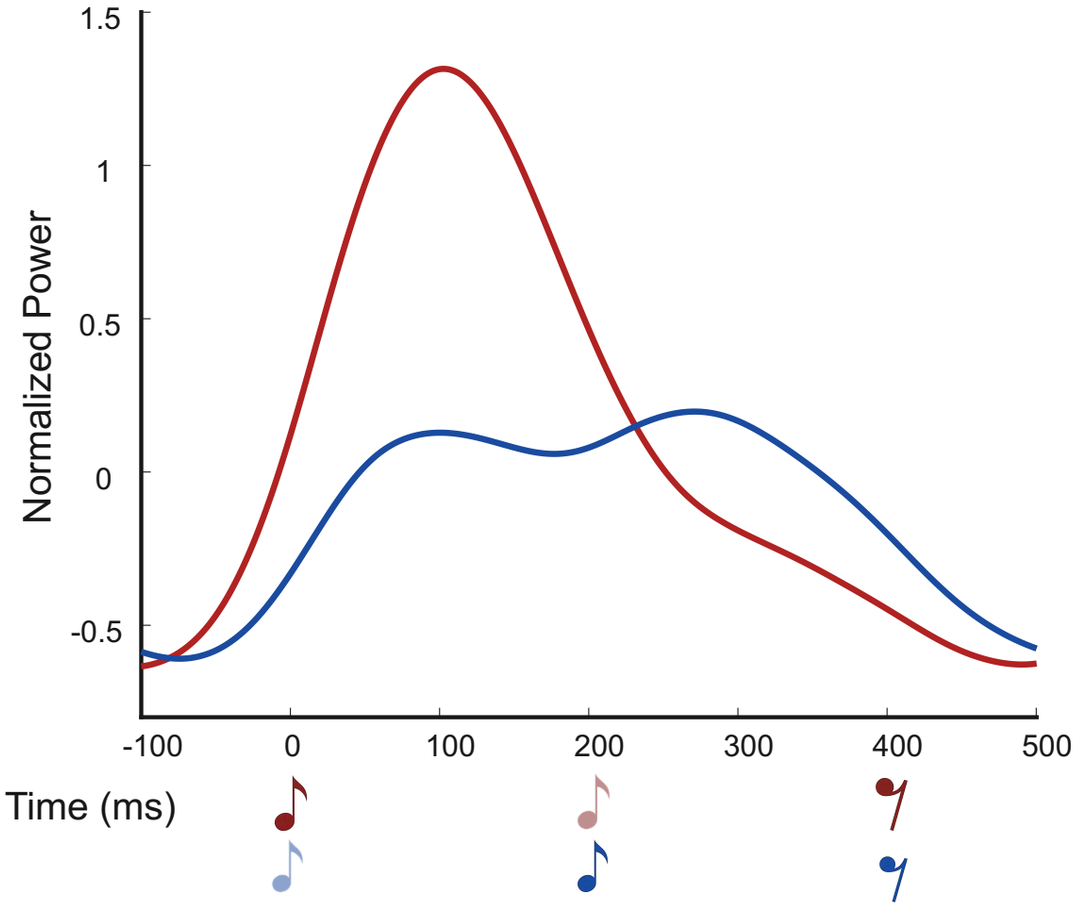
Kasdan, Gordon, & Lense. *Biol Psych:CNNI. 2020.*

Individuals with WS exhibit greater modulations of evoked alpha power

Alpha: 8-12Hz

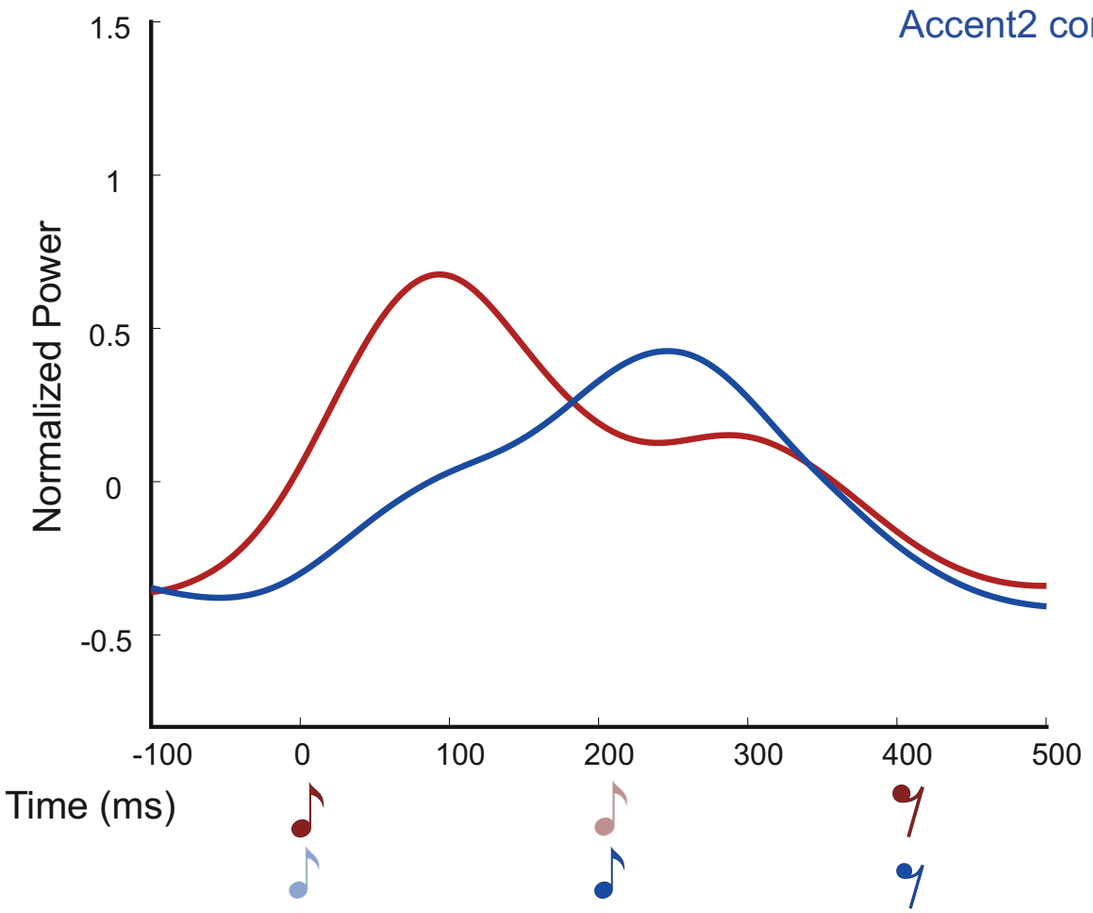
Attention and inhibition

Alpha, WS Group



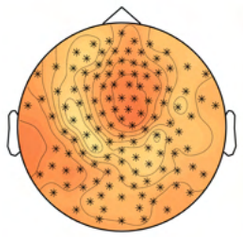
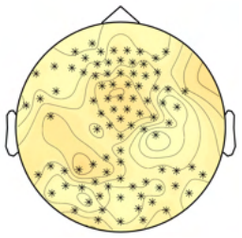
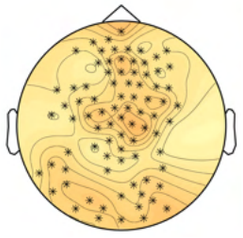
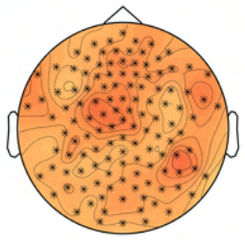
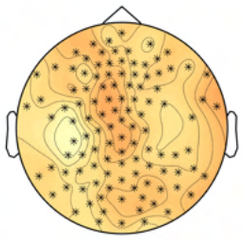
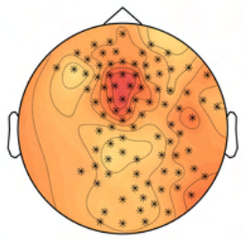
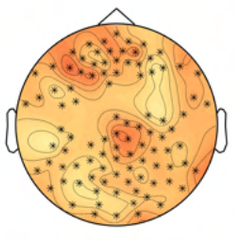
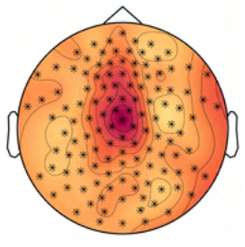
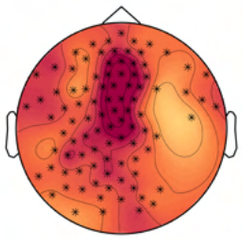
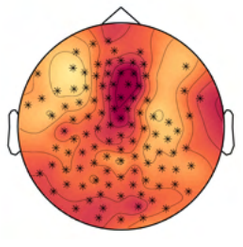
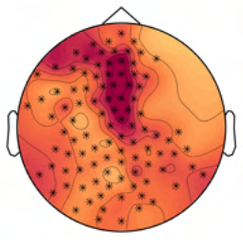
Alpha, TD Control Group

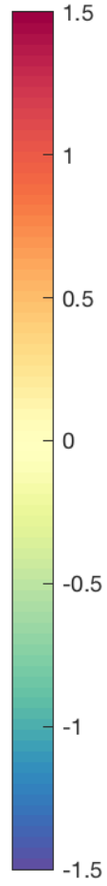
Accent1 condition
Accent2 condition



Kasdan, Gordon, & Lense. *Biol Psych:CNNI. 2020.*

Individuals with WS have a somewhat more distributed neural response

	WS group		TD control group	
	Beat1 effect	Beat2 effect	Beat1 effect	Beat2 effect
Alpha (8-12 Hz)				n.s.
Beta (13-30 Hz)				
Gamma (31-55 Hz)				



Kasdan, Gordon, & Lense. *Biol Psych:CNNI. 2020.*

Take Homes

1. Beat perception in Williams syndrome is reflected by the amplitude and stability of auditory ERPs.

2. Individuals with WS exhibit similar beta and gamma evoked activity and greater modulations in evoked alpha power compared to neurotypical controls.

3. Individuals with WS exhibit a profile of dynamic beat tracking similar to and different from neurotypical controls.

4. Results coincide with the heightened auditory sensitivities and attentional difficulties in WS.

“It’s like falling in love but instead of a girl, it’s music.”

“When you practice guitar, do you use a metronome or your heart to feel the beat?”