Visual temporal integration windows in 2-year-old toddlers with and without autism

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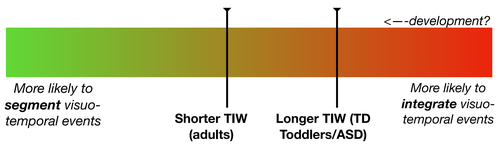
Introduction & Motivation

The *Temporal Integration Window* (TIW) is a basic 'unit' of temporal processing: *stimuli within the same window are integrated; in different windows, segmented (VanRullen 2016; Wutz et al. 2016).*

Differences in TIWs can affect how one perceives the world, contributing to developmental differences and neurodevelopmental disorders, such as autism spectrum disorder (ASD).



Previous work has been inconclusive. Farzin et al. (2011) found slower processing in infants with Fragile X Syndrome (the most common single gene cause of autism), whereas Falter et al. (2012) found that adults with ASD had *increased* temporal resolution. But do these results reflect differences in temporal processing, per se, or differences in general (e.g. visual/engagement) factors? *Measuring both integration and segmentation - i.e. the TIW - in the same paradigm & individual isolates temporal processing.*

We measured TIWs in typically developing 18-36-month-olds and toddlers diagnosed with ASD.

TIWs have only been studied in adults and school aged children (Wutz et al. 2016; Freschl et al., under review)*. No work has directly investigated TIWs in TD toddlers and toddlers diagnosed with ASD.

**Wutz et al. 2016: adult TIW = 65 ms. Freschl et al. (under review): 5-7 year old children = 68 ms; adult = 73 ms.*

Participants

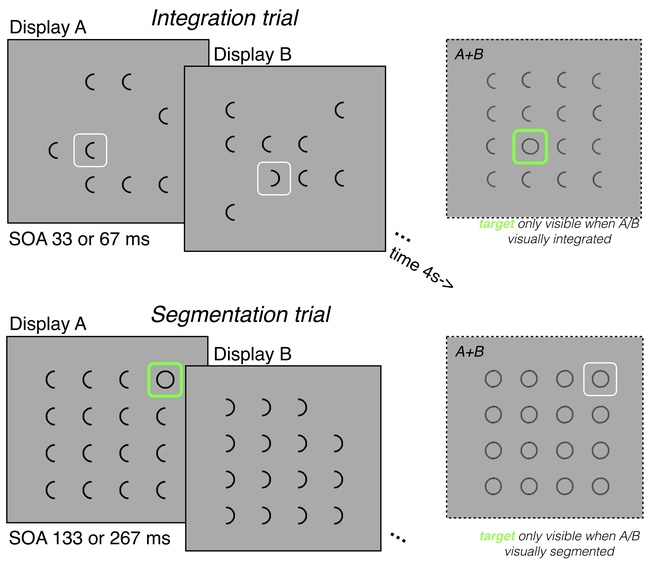
	ASD - mean (SD)	TD - mean (SD)	*p*	Effect size (d)
N	50 (49 w/ Mullen)	59 (40 w/ Mullen)	-	-
Females	19	27	-	-
Age (months)	27.67 (5.59)	27.59 (5.05)	0.94	0.02
Range (months)	18-36	18-36	-	-
Mullen VR	28.61 (9.98)	57.63 (13.34)	<0.001	-2.50
Mullen FM	28.06 (10.04)	47.25 (10.46)	<0.001	-1.88
Mullen RL	22.49 (6.73)	53.88 (10.02)	<0.001	-3.75
Mullen EL	27.71 (7.96)	54.40 (12.81)	<0.001	-2.56
Mullen ELC	58.71 (11.04)	109.17 (19.60)	<0.001	-3.26
ADOS SA	8.25 (1.69)	-	-	-
ADOS RRB	9.41 (0.98)	-	-	-
CSS	8.74 (1.52)	-	-	-

ASD diagnosis was verified by a clinical psychologist using the Autism Diagnostic Observation Schedule (ADOS). Participants were excluded if they did not receive a diagnosis (an additional 15 participants).

Methods

Visual search <u>eye-tracking</u> task

based on 'missing dot' displays (Di Lollo 1980; Wutz et al. 2016)



Gray boxes show target constituent parts, and the green box indicates the target (assuming visual integration / segmentation of the A/B displays). Boxes were not shown during testing.

Participants were presented with a 4s sequence of two displays (ABAB…) each exposed for a parametrically-varied stimulus onset asynchrony (SOA).

Longer SOA's increase the likelihood of perceiving the target on segmentation trials, but decrease the likelihood of perceiving it on integration trials (and visa versa). If the target was fixated, the trial was coded as correct.

***Difference scores** measured an individual's relative performance (integration - segmentation) overall. A large difference score indicates relatively longer TIWs while a smaller difference score reflects shorter TIWs.*

*Integration & segmentation performance was determined as a function of SOA. The **crossover point** where these functions intersect defines a group's TIW.*

Acknowledgement & References

This project was supported by a grant from the National Institute of Mental Health (R21MH117787)

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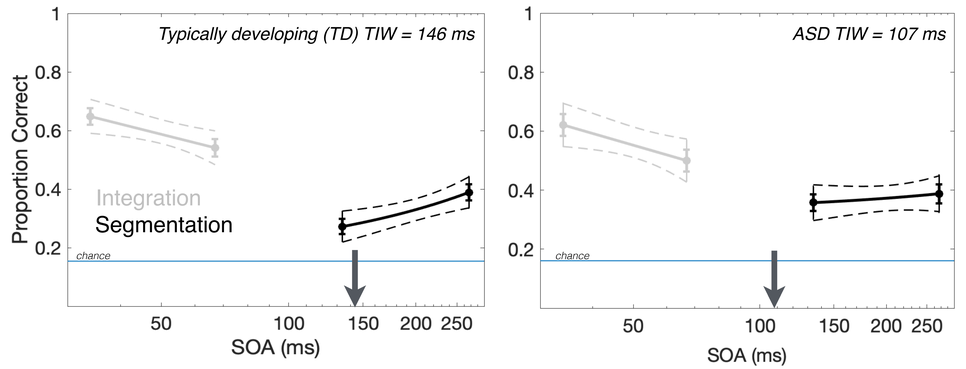
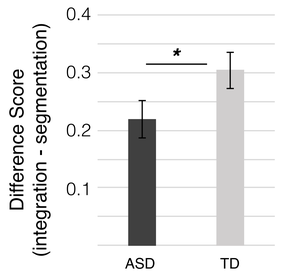
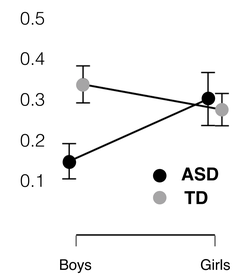
Results

Search performance, for integration & segmentation-defined targets, as a function of rate (SOA)

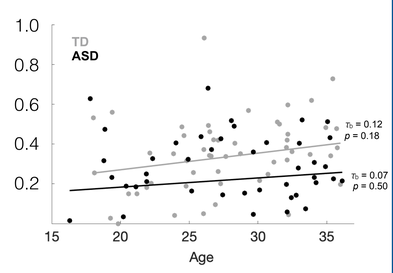




Difference scores indicate the ASD group has faster temporal processing ($p = 0.04$).



This is driven primarily by the boys (boys with ASD have lower difference scores than TD boys ($p = 0.03$)).



Difference scores did not change with age, in either group

Conclusion

Overall, we found much longer TIW's (~100-150ms) in 18-36-month-olds than previously found in TD 5-7 year olds and adults (~70 ms) (Freschl et al., under review). Thus, **TIWs narrow in the first few years of life.**

We did not find a relationship between autism severity, or mental age (ELC Mullen score), and temporal processing.

These findings are in line with Falter et al. (2012), who found that adults with ASD have increased temporal resolution, and Nakano et al. (2010), who found poorer temporal integration.

Toddlers with ASD had higher temporal resolution than age-matched TD controls, suggesting a greater ability to segment visual information in time, at the cost of integrating information into a unitary representation.

This effect interacted with gender: boys with ASD drove the effect. While TD males have been shown to have higher temporal resolution, e.g. shorter motion discrimination thresholds (Murray et al. 2018) than TD females, we did not find a main effect of gender. Further research is required here.

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