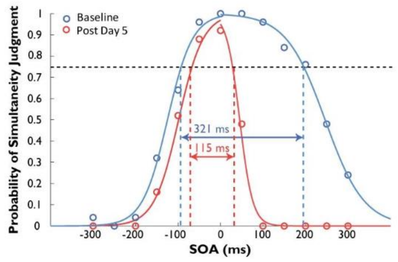
Multisensory Perceptual Training in Autistic Youth: A Randomized Controlled Trial

J. I. Feldman[1,2], K. Dunham[3,4], G. E. DiCarlo[3,4], M. Cassidy[3], Y. Liu[3], E. Suzman[3], Z. J. Williams[2-4], G. Pulliam[3], S. Kaiser[3], M. T. Wallace[2-5], and T. G. Woynaroski[1,2,4,5]

[1]Vanderbilt University Medical Center, [2]Frist Center for Autism and Innovation, [3]Vanderbilt University, [4]Vanderbilt Brain Institute, [5]Vanderbilt Kennedy Center

Background

- Autistic youth often present with differences in processing multisensory information, notably in their abilities to combine audiovisual information.
- Previous work suggests temporal binding of audiovisual speech can be trained (i.e., temporal binding windows [TBWs] can be narrowed) in non-autistic adults.



Purpose

- The purpose of this study was to evaluate whether a computer-based perceptual training in youth with autism results in (a) narrower TBWs within the training task, (b) narrower TBWs on trained stimuli, and (c) narrower TBWs on untrained speech stimuli and/or speakers.
- We also assessed whether treatment outcomes varied according to individual characteristics (i.e., language ability, non-verbal cognitive ability).

Procedure

- Participants were 30 autistic youth who were randomized into a perceptual training group and a control group in pairs matched on age, biological sex and gender, and pre-training TBW. Participants additionally did not differ on the basis of Nonverbal IQ (as assessed by the Leiter-3) and Core Language (as measured by the PLS-5 or CELF-4).

	Perceptual Training ***M* (*SD*)**	**Control** ***M* (*SD*)**
Chronological Age (years)	14.2 (4.0) Range: 8.1 – 21.3	14.0 (3.6) Range: 8.4 – 19.2
Nonverbal IQ	113.2 (12.1) Range: 93 – 139	108.7 (24.6) Range: 45 – 147
Core Language Standard Scores	92.5 (20.3) 48 – 118	92.0 (25.9) 40 – 120
Pre-Training TBW (Trained Stimuli)	533.0 (213.0) 173.4 – 850.0	498.8 (257.1) 191.7 – 1110.6
Biological Sex	11 males, 4 females	10 males, 5 females

- Participants in the Perceptual Training condition completed an 8 day training (4 days per week over 2 weeks), wherein they completed seven rounds of an audiovisual perceptual training. The training provided feedback on each trial of a speech simultaneity judgment (SJ) task using six different speakers and was designed such that one round would be considered easy, two rounds would be considered medium difficulty, and four rounds would be considered hard, based on the participant's performance the previous day.
- Participants in both groups attended a half-day research camp over the same 8 days.

Analytic Plan

- At pre- and post-test, participants completed three SJ tasks that utilized different stimuli. From each of these tasks, we derived TBWs:
  - $TBW_{Trained}$ = Speaker included in the training saying "ba"
  - $TBW_{Novel\ speaker}$ = Speaker not included in the training saying "ba"
  - $TBW_{Novel\ syllable}$ = Speaker included in the training saying "pa"
- Missing data were imputed using the *missForest* package in R.
- Post test TBWs were analyzed using multiple regression analyses to evaluate (a) the effect of group and (b) the interaction between group and putative moderators (i.e., language ability, non-verbal cognitive ability). Post-hoc Johnson-Neyman tests were utilized to identify cut-off regions following significant moderation analyses.

No Unconditional Effects of Group

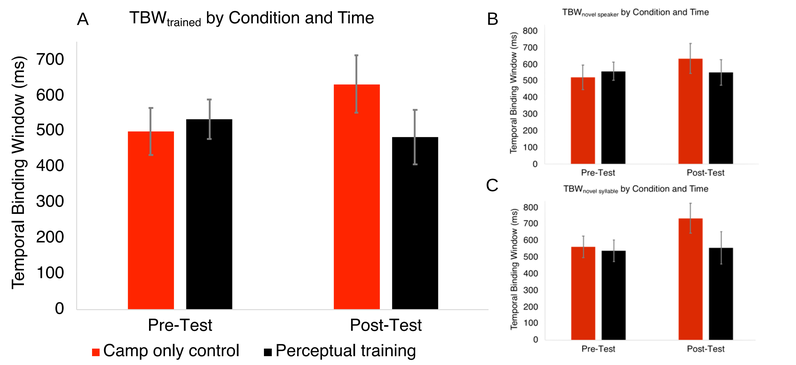


Figure 1. Group comparisons on all stimuli were nonsignificant. There was no effect of group on (a) trained stimuli (β = 148.0, p = 0.19, Hedge's g = 0.47), (b) novel speaker stimuli (β = 84.4, p = 0.54, Hedge's g = 0.22), or (c) novel syllable stimuli (β = 178.1, p = 0.19, Hedge's g = 0.47).

Effects Moderated By Cognition

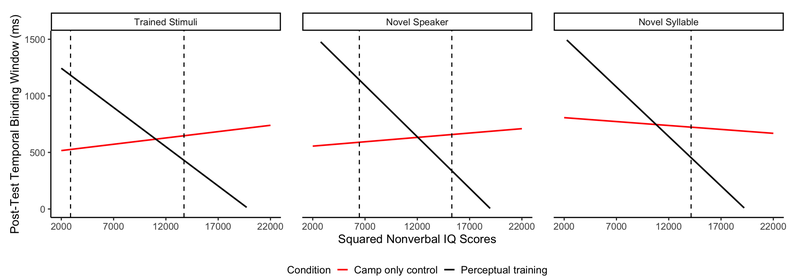


Figure 2. Nonverbal IQ moderated the effect of the training on all outcomes (p values < .05). The training was beneficial for youth with higher nonverbal IQs and detrimental for those with lower nonverbal IQs. Nonverbal IQ scores were squared to correct for skew; back-transformed regions defined by Johnson-Neyman tests (denoted by dotted lines) were 54 and 117 for trained stimuli, 80 and 123 for novel speaker stimuli, and 118 for novel syllable stimuli.

Effects Moderated By Language

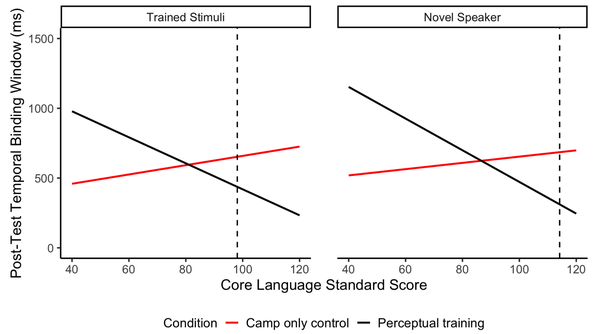


Figure 3. Language standard scores (measured by PLS-5 or CELF-4) also moderated the effect of the training on $TBW_{trained}$ and $TBW_{novel\ speaker}$ (p values < 0.05). Johnson-Neyman tests indicated training was beneficial for those with higher language ability (SS > 98 and 114, respectively; dotted lines above).

Discussion and Future Directions

- The perceptual training works for some, but not all, autistic youth.
- It is most likely to benefit autistic youth with at least above average nonverbal cognitive ability and at least average language ability. It may be detrimental to autistic youth with below average nonverbal cognitive ability.
- Future research should develop and evaluate novel ways to intervene on audiovisual integration abilities in autistic youth with below average language and cognitive ability.
- We are working to evaluate (a) whether the perceptual training program yields more distal effects, and (b) whether neural processing of audiovisual speech mediates effects of the training on outcomes of interest, at least for the subgroup of more cognitively and linguistically able youth with autism.

Select References

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