Executive Functioning in Bilingual Children with ASD: Are there advantages of being bilingual?

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BACKGROUND

- Executive functions comprise skills that are important for daily life such as working memory, planning, inhibition, and set-shifting (Eigsti, 2011).
- Enhanced executive functioning on set-shifting tasks has been reported in bilinguals relative to monolinguals (e.g., Bialystok & Martin, 2004; Bialystok & Viswanathan, 2009), with bilinguals showing faster reaction times than their monolingual counterparts. In contrast, other executive functions such as working memory were not enhanced (e.g., Engel de Abreu, 2011).
- Autism Spectrum Disorders (ASD) is a condition with known EF impairments. Children with ASD tend to exhibit perseverative responses in set-shifting tasks (e.g., Ozonoff et al., 2004). Conversely, they show intact verbal short-term memory (e.g., Boucher et al., 2012; Zinke et al., 2010).
- If a bilingual advantage exists for executive functions, it may mitigate the set-shifting impairments observed in ASD.

OBJECTIVES

We examined the impact of bilingualism on executive functioning:

- We hypothesized that bilingual children with ASD would be impaired in set-shifting relative to bilingual typically-developing (TYP) children, but would be less impaired than monolingual children with ASD (biTYP > biASD > monoASD).
- As a control we hypothesized that short-term memory would not differ between groups.

METHODS

PARTICIPANTS *Target sample size is 15 in each group, data collection is ongoing.*

- The three groups were matched on chronological age, nonverbal IQ and dominant language (4 French-dominant and 3 English-dominant participants per group).
- They were speakers of French, English, or Spanish (or any 2 of these languages).
- Children with ASD had community diagnoses confirmed by SCQ and nonverbal IQ in the normal range. Bilinguals and monolinguals with ASD did not differ significantly in SCQ scores, $p = .15$.
- No significant differences were found between groups in gender, $\chi^2 = 5.60$, $p = .06$ or socioeconomic status (via parent level of education), $\chi^2 = 4.20$, $p = .38$.

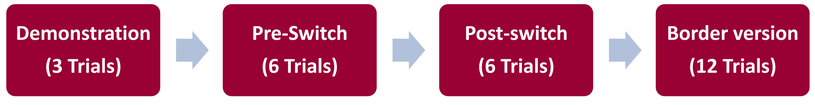
	Bilingual ASD (n=7) M *(SD)*	Monolingual ASD (n=7) M *(SD)*	TYP Bilinguals (n=7) *M (SD)*	*p* value
Age in months	101 *(11.3)*	100 *(11.6)*	97*(11.9)*	.79
Range (years)	7;3 – 9;11	6;10 – 9;5	6;11 – 9;8	
NVIQ (Leiter)	112.4 *(10.9)*	112.3 *(11.4)*	112.7 *(9.2)*	.99
Gender	Male 5 Female 2	Male 7 Female 0	Male 3 Female 4	.06

MEASURES

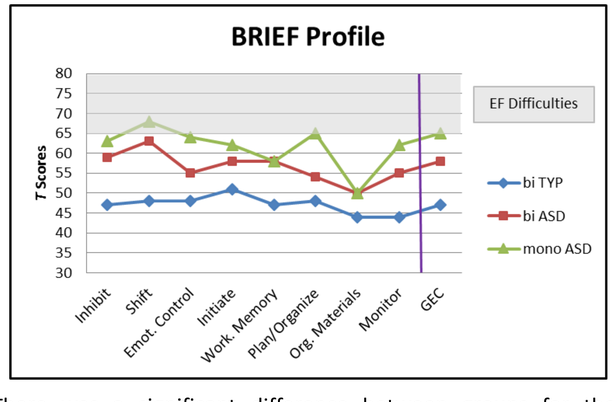
- **Parent report of executive function in daily life:** The Behavior Rating Inventory of Executive Functioning (**BRIEF**; Gioia, Isquith, Guy, & Kenworthy, 1996). Higher scores = Greater degree of executive *dysfunction.*
- **Direct assessment of set-shifting:** Computerized version of the Dimensional Change Card Sort task (**DCCS**; Zelazo, 2006).
- **Short-term memory:** The **number repetition** subtest of the Clinical Evaluation of Language Fundamentals (**CELF-4**; Semel, Wiig, & Secord, 2003).

PROCEDURE

- **DCCS Task.** Children were asked to sort a series of images (boats and rabbits) according to one dimension (e.g., color). Afterwards, they were asked to sort the same images according to another dimension (e.g., shape; Zelazo, 2006).
- During demonstration the experimenter provides an example of the sorting strategy (e.g., color). Then, in the pre-switch phase, the child sorts objects based on the rule given during demonstration. Afterwards, in the post-switch phase, the child is asked to change sorting strategy. Participants pass if they correctly sort 5 of 6 post-switch trials.
- If participants passed the post-switch phase they went onto a more advanced phase (i.e., border version; Zelazo, 2006). Here children were asked to sort by color if the picture had a border, or by shape if the picture did not have a border. A pass requires correctly sorting at least 9 out of 12 trials.

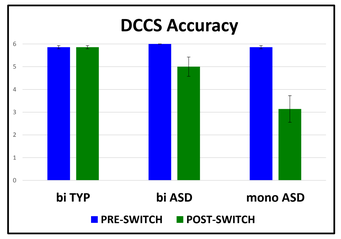


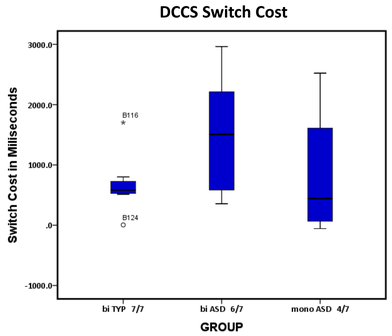
RESULTS



- **BRIEF.** There was a significant difference between groups for the General Executive Composite (GEC) score, $F(2,18) = 6.29$, $p = .008$, eta squared =.41. Scores patterned in line with our prediction with only the monolingual ASD group performing in the range of impairment. Bilingual TYP M = 47, *SD = 6.87*; Bilingual ASD M = 58, *SD = 12.8*; Monolingual ASD M = 65, *SD = 8.23*. The same pattern was found for the Shift sub-scale ($p = .009$).
- A Bonferroni post-hoc test revealed that the **Bilingual TYP and Monolingual ASD groups were significantly different ($p = .007$), however the Bilingual TYP and Bilingual ASD groups were not ($p = .14$).** Monolingual and Bilingual ASD groups ($p = .55$) were also not significantly different.

DCCS Task. The percentage of children passing the DCCS post-switch phase was: Bilingual TYP = 7/7, Bilingual ASD 6/7, Monolingual ASD = 4/7, χ^2 (2) = 5.15, $p = .08$. There were no significant differences between groups in in reaction time switch cost ($p = .28$), or in passing the Border version of the DCCS task, χ^2 (2) = 5.0, $p = .08$.





CELF-4. There were no significant differences between groups on the number repetition task, $F(2,18) = 1.64$, $p = .22$. Number repetition scaled scores were: Bilingual TYP M = 11.7, *SD = 2.4;* Bilingual ASD M = 9.1, *SD = 3.5;* Monolingual ASD M = 9.7 *SD =2.3*).

DISCUSSION AND CONCLUSIONS

- There was a significant difference in parent-reported EF skills on the BRIEF, where higher scores indicate greater *dysfunction.* Confirming their set-shifting impairment, monolingual children with ASD exhibited significant dysfunction relative to bilingual typically-developing children. However bilinguals with ASD exhibited less dysfunction and did not significantly differ from TYP bilinguals.
- As predicted, a greater percentage of bilingual children with ASD passed the post-switch phase of the DCCS relative to monolinguals with ASD, although this difference was not significant. Interestingly, the bilingual ASD group was more accurate but slower in switching from one dimension to another.
- Verbal short-term memory was similar across groups. These findings corroborate previous studies reporting that bilingualism benefits some domains of EF (e.g., set-shifting) but not others (e.g., short term memory).
- These preliminary findings suggest that being bilingual may positively impact set-shifting abilities in ASD, contrary to conventional wisdom that bilingualism is too challenging for children with developmental disabilities.
- Data from our full sample will allow us to more clearly answer if the set-shifting difficulty experienced by monolinguals with ASD is significantly reduced in bilinguals with ASD.

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