# Does being bilingual impact executive functions in Autism Spectrum Disorders?

**Ana Maria Gonzalez-Barrero & Aparna Nadig**

School of Communication Sciences and Disorders, McGill University, Centre for Research on Brain, Language and Music

## BACKGROUND

- Executive functions (EF) comprise skills essential for daily life. One of these is cognitive flexibility, often measured by set-shifting tasks (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., Bialystok & Feng, 2011; Engel de Abreu, 2011).
- Here we examine effects of bilingualism on Autism Spectrum Disorders (ASD), 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 set-shifting abilities:**

- 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), $\chi^2$ = 5.92, $p$ = .21.

| | 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)* | 98 *(12.5)* | .92 |
| Range (years) | 7,3 – 9,11 | 6,10 – 9,5 | 6,11 – 9,8 | |
| NVIQ (Leiter) | 112.4 *(10.9)* | 112.3 *(11.4)* | 112.1 *(9.0)* | .99 |
| Gender | Male 5 Female 2 | Male 7 Female 0 | Male 3 Female 4 | .06 |

**MEASURES**

- **Set-shifting:** Computerized version of the Dimensional Change Card Sort task (**DCCS**; Zelazo, 2006).
- **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.*
- **Short-term memory:** The **number repetition** subtest of the Clinical Evaluation of Language Fundamentals (**CELF-4**; Semel, Wiig, & Secord, 2003).

**PROCEDURE**

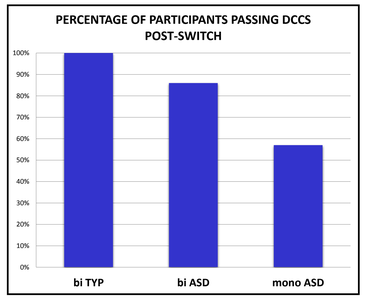
- **DCCS Task.** Children were asked to sort a series of images (boats and rabbits) according to one dimension (e.g., color). Afterwards, children should sort the same images according to another dimension (e.g., shape; Zelazo, 2006).
- The DCCS includes 4 phases. First, there is a demonstration phase in which the experimenter provides an example of the sorting strategy (e.g., color). Then, in the pre-switch phase, the child should sort 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.

Demonstration (3 Trials) → Pre-Switch (6 Trials) → Post-switch (6 Trials) → Border version (12 Trials)

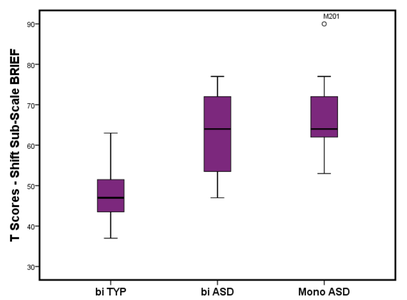
## RESULTS

- **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, $\chi^2$ (2) = 5.15, $p$= .08. There were no significant differences between groups in passing the Border version of the DCCS task, $\chi^2$ (2) = 2.75, $p$= .25.
- **BRIEF.** There was a significant difference between groups for the shift sub-scale of the BRIEF, $F(2,18)$ = 6.03, $p$ = .01, eta squared =.40. Scores patterned in line with our prediction: Bilingual TYP M = 48.1, *SD = 8.34*; Bilingual ASD M = 62.7, *SD = 12.12*; Monolingual ASD M = 67.9, *SD = 12.16*. The same pattern was found for the General Executive Composite Score.
- **BRIEF.** A Bonferroni post-hoc test revealed that the Bilingual TYP and Monolingual ASD groups were significantly different ($p$ = .01), whereas the Monolingual and Bilingual ASD groups ($p$ = 1.0) and Bilingual TYP and Bilingual ASD groups ($p$ = .07) were not.
- **CELF-4.** There were no significant differences between groups on the number repetition task, $F(2,18)$ = 1.91, $p$ = .18. Number repetition standard scores were: Bilingual TYP M = 11.3, *SD = 1.7;* Bilingual ASD M = 9.0, *SD = 3.1;* Monolingual ASD M = 9.1 *SD =2.4*).

**DCCS**




**BRIEF**




## DISCUSSION AND CONCLUSIONS

- 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. Reaction time analysis will be conducted for the DCCS task to obtain a more sensitive measure of set-shifting skills. In contrast, 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).
- There was a significant difference in parent-reported set-shifting 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.
- Our findings add to the sparse literature on bilingualism and EF in neurodevelopmental disorders. 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.

## REFERENCES AND ACKNOWLEDGMENTS

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