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Research Proposal

I have had the opportunity to conduct research and interventions with children from diverse backgrounds. These experiences increased my interest in the factors that influence cognitive development in young children. I am particularly interested in the impact of environmental variables on brain development among children from underserved backgrounds. More specifically, I want to develop empirically-validated ways to foster the development of skills and abilities relevant to academic achievement in children at risk of school failure as a way to address educational disparities. I want to engage in doctoral research that draws on findings from cognitive neuroscience, expanding on previous work implementing successful educational interventions, and bringing together elements from my previous research experiences studying language and learning processes.

Previous research suggests that socioeconomic status (SES) has an adverse impact on important cognitive abilities related to language and executive function, with children from lower SES backgrounds performing worse compared to their higher SES peers on measures of these abilities [1,2]. This evidence suggests that the neurocognitive systems supporting these abilities are vulnerable to the adverse impacts of exposure to deprived environments. Therefore, mediators of the association between low SES and underperformance on tasks taxing these systems need to be explored, as these basic executive function processes are associated with indices of school readiness and academic achievement [3]. Research on the development of executive function in bilingual children suggests a bilingual advantage in cognitive control, with bilingual children being better at inhibiting interfering irrelevant information [4], and at executive function tasks involving conflict, when adjusting for SES [5]. Neuroimaging evidence has shown that interventions targeted at the executive attention network lead to gains on executive function measures [6]. I propose to compare the effect of previously found successful executive function interventions on bilingual and monolingual children from different SES backgrounds to examine whether SES and the bilingual advantage moderate the effect of targeted interventions on children's executive functioning.

I would accomplish this aim by studying groups of low-SES English monolingual 5-year old children and low-SES English-Spanish bilingual children of the same age. Compared to Caucasian and African American children, Hispanic children respond more proficiently to the interference of competing demands when SES is adjusted for [7], suggesting that these children might be benefiting from exposure to both English and Spanish. Maturational differences in executive functioning have been found between 4- and 6-year old children [6], suggesting that this network is still under development in 5-year old children; this age group is thus a good candidate for study. Performance on a flanker task adapted from the child version of the Attention Network Test (ANT) will be measured at baseline. This task has been validated as a measure of executive function skills that involve conflict in children [6], as it entails suppression of irrelevant information, introduced via incongruent flankers surrounding the target, to minimize interference to attend to relevant information. A group of high-SES English monolingual children will be included as a control at baseline to tease apart the effects of language exposure vs. socio-economic status. A subset of the experimental groups will be assigned to a 5-day training consisting of tracking, anticipation, stimulus discrimination, conflict resolution and inhibitory control exercises with increasing levels of difficulty. This intervention

program has been found to improve performance on the ANT in young children [6]. The flanker task will be administered after training is completed to both the intervention and no-intervention groups to compare to results at baseline and to examine group differences. Event-related potentials (ERPs) in the N2 time-window to congruent flanker vs. incongruent flanker trials will be measured at baseline and post-training at frontal and fronto-parietal electrode sites for each group to examine differences in brain activation as an effect of training and language experience. The N2 is an ERP index at 200-400 ms post-stimulus associated with recruitment of incorrect response inhibition in conflict monitoring, presenting a larger amplitude for conditions representing more conflict due to interfering incongruent information [8].

In line with the bilingual advantage hypothesis, I predict that at baseline the bilingual group will out-perform the monolingual group on the flanker task, indicated by faster reaction time and higher accuracy rate. The monolingual high-SES group will outperform both the bilingual and the monolingual-low-SES groups, with this difference disappearing for the bilingual low-SES group, but not for the monolingual one, after adjusting for SES. At post-test, the intervention group will perform better than the control group on the task, and will show a significant N2 amplitude difference to congruent vs. incongruent trials, suggesting improvements in attention regulation and conflict monitoring. Children in the monolingual intervention group will show more gains in both the behavioral and the electrophysiological measures, compared to the bilingual intervention group, as children with poorer initial performance are more likely to show training effects [6]. The effect of training in the bilingual intervention group will reduce the difference in performance predicted in this group at baseline compared to the high-SES monolingual group, so that post-training of the bilingual group the differences in performance between these two groups will become negligible without the need to adjust for SES.

These anticipated results would suggest that children from low-SES backgrounds, who have been shown to be at risk for school failure, benefit from interventions targeting the executive function network. Furthermore, they would indicate that bilingualism moderates the effects of SES on executive control tasks involving conflict, both at the behavioral and brain level. This evidence would empirically validate the effectiveness of implementing targeted interventions and of promoting bilingualism in young children as a means of mediating the ill effects of SES on child development. It would be important to assess if the effects of this short training are sustained, as well as examine how they translate into academic achievement. This line of research will help inform educational practice to assist in closing the achievement gap between low- and high-SES children.

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