Abstract Title Page
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Title: Family-based training program improves brain function, cognition, and behavior in lower socioeconomic status preschoolers

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Abstract Body

Limit 4 pages single-spaced.

Background / Context:

Description of prior research and its intellectual context.

Here we present a study that illustrates the potential for the application of results from basic research in cognitive neuroscience to the design of interventions (Neville, et al., under review).

For several years we have employed psychophysics, electrophysiological (ERP) and magnetic resonance imaging (MRI) techniques to study the development and neuroplasticity of the human brain. Over the course of this research we have observed that different brain systems and related functions display markedly different degrees or "profiles" of neuroplasticity (for review, see Stevens & Neville, 2009). Some systems appear quite strongly determined and are not altered even when experience has been very different, while other neural systems remain capable of change by experience throughout life. Most relevant for the application of research in cognitive neuroscience to the design of education interventions are results showing that some systems are highly modifiable by experience and are dependent on experience but only during particular time periods ("sensitive periods"). In such systems we have also observed the two sides of neuroplasticity in several domains of processing. Systems that are most modifiable (i.e., display more neuroplasticity) display both enhancements in the deaf and blind, and greater vulnerability in those with or at risk for developmental disorders. One system that displays this profile is sustained selective attention. Considerable evidence documents the central role of selective attention in all aspects of learning and memory, and school readiness in particular (for review, see Stevens & Bavelier, 2012). Selective attention is a highly malleable system that is both enhanced in remaining modalities following sensory deprivation, shows deficits in developmental disorders and in typically developing children from lower socioeconomic status (SES) backgrounds and that can be increased in both typically and non-typically developing children following computerized training (Stevens & Neville, 2009; Stevens, Lauinger, & Neville, 2009; Stevens, et al., 2008). The impact of lower SES on the cognitive skills and brain function of children and adults has been well documented (for review, see Hackman et al., 2010).

Purpose / Objective / Research Question / Focus of Study:

Description of the focus of the research.

Guided in part by the findings described above, we developed and assessed an eight-week, family-based training program designed to improve lower SES preschool children's academic readiness and, centrally, selective attention.

Setting:

Description of the research location.

Brain Development Laboratory at the University of Oregon and Head Start sites in Lane County, Oregon.

Population / Participants / Subjects:
Description of the participants in the study: who, how many, key features, or characteristics.

141 3-5 year-old children enrolled in Head Start (HS) and their parents. All children were monolingual, native English speakers living at or below the poverty level. Children taking psychoactive medications or with diagnosed behavioral or neurological syndromes (e.g., epilepsy, ADHD, specific language impairment) and/or Individualized Family Service Plans were excluded from participation.

Intervention / Program / Practice:
Description of the intervention, program, or practice, including details of administration and duration.

The training program, Parents and Children Making Connections: Highlighting Attention (PCMC-A), included both a child-directed component, as well as a family-based, parent directed component. Parents attended eight weekly, two-hour small-group classes that occurred in the evenings or on weekends at HS sites, and their children participated in concurrent small group training activities.

Child component

The child component of PCMC-A included a set of 20 small group activities (4-6 children: 2 adults) designed to address the overarching goals of increasing self-regulation of attention and emotion states. The activities targeted aspects of attention including vigilance, selective attention, and task switching. All activities were tested and developed with input from HS teachers at schools not participating in our study. In each session, children completed two to four of the activities as part of the small group.

Parent component

The parent component of PCMC-A was an adaptation of the evidence-based curriculum Linking the Interests of Families and Teachers (LIFT) developed at the Oregon Social Learning Center (Reid, et al., 1999). The LIFT intervention was originally developed as a universal conduct disorder prevention program and emphasizes parenting techniques such as positive reinforcement of pro-social behavior, effective non-punitive limit setting, and consistent monitoring of children's behavior. The adapted LIFT intervention consisted of a scaffolded set of 25 strategies delivered in small group format (the parents of 4-6 children: 1 interventionist) to address the overarching goals of (a) family stress regulation with consistency and predictability, planning, and problem solving strategies; (b) contingency-based discipline; (c) parental responsiveness and language use with child; and (d) facilitation of child attention through explicit instruction on the development of attention and links to attention training exercises we employ with their children. Small-group instruction was supplemented with weekly support calls, during which the interventionist confirmed the correct implementation of home-practice activities, clarified instruction points, and provided family-specific suggestions in response to parents' experiences.

Research Design:
Description of the research design.

Children and their parents were randomly assigned to PCMC-A or one of two comparison groups. One comparison group, HS-alone, participated in HS but received no supplemental services or activities. The second comparison group, Attention Boost for Children (ABC), was an

active training comparison program of equivalent intensity in terms of contact hours, but unlike PCMC-A, the focus of the program was primarily on child classroom training.

Data Collection and Analysis:
Description of the methods for collecting and analyzing data.

Prior to and following the eight-week intervention period, a multi-method, multi-rater assessment was conducted. The primary outcome measure was an electrophysiological measure of children's brain functions supporting selective attention. Children were also assessed using a standardized assessment battery including non-verbal IQ, receptive language, and preliteracy skills by testers blind to children's experimental group, and also employing parent and teacher reports of children's social skills and problem behaviors. Finally, given the predicted role of the program on parents themselves, we examined parent self-reports of parenting stress levels as well as parent self-reports of their parenting confidence and ability. In addition, a seven-minute video recording was also taken of a play dyad between parent and child to objectively quantify four aspects of parent/child interaction: parents' turn-taking, lexical diversity, language modeling, and mean length of utterance.

Findings / Results:
Description of the main findings with specific details.

As illustrated in Figs. 1 and 2, electrophysiological measures of children's brain functions supporting selective attention, standardized measures of cognition, and parent-reported child behaviors all favored children in the treatment program relative to both control groups. Positive changes were also observed in the parents themselves. Effect sizes ranged from one-quarter to one-half of a standard deviation.

Conclusions:
Description of conclusions, recommendations, and limitations based on findings.

These results illustrate the potential for the application of results from basic research in cognitive neuroscience to the design of intervention. Specifically, these results show that a program that targets child attention using a family-based model involving children and their parents is highly effective in changing children's neurocognitive function as well as their parents' caregiving behaviors in the relatively short timeframe of eight weeks. The evidence presented here suggests that programs that target multiple pathways, including parents and the home environment, have the potential to narrow the large and growing gap in school readiness and academic achievement between higher and lower SES children.

Appendices

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Appendix A. References

References are to be in APA version 6 format.

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Stevens C & Bavelier D (2012) The role of selective attention on academic foundations: A cognitive neuroscience perspective. *Developmental Cognitive Neuroscience* 2S:S30-48.

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Stevens, C. and Neville, H. (2009). Profiles of development and plasticity in human neurocognition. In M. Gazzaniga (ed), *The Cognitive Neurosciences IV,* MIT Press, Cambridge, pp. 165-181.

Appendix B. Tables and Figures

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Figure 1. Event-related potentials from the selective auditory attention paradigm, averaged across all participants in each group, separately at pre-test and at post-test. Children were cued to attend selectively to one of two stories presented simultaneously from separate speakers located to the left and right of the child. The electrophysiological response to identical probes embedded in attended and unattended stories was compared. Significantly greater increases in the ERP early attentional modulation (100-200 ms) in children in the PCMC-A group compared to the HS-alone and ABC groups in representative waveforms from centro-parietal electrode P4.

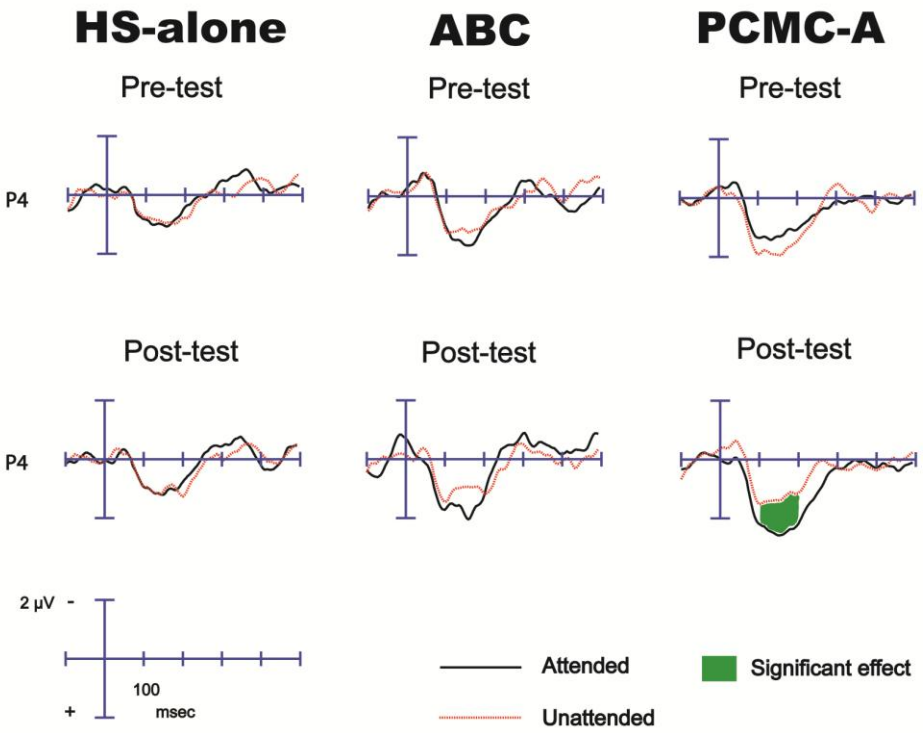

Figure 2. Significantly greater changes in the PCMC-A group compared to HS-alone and ABC groups in three domains: changes in parents, parent reports of changes in child behavior, and changes in child cognition. Error bars represent SE.