Effects of an integrated two-generation intervention on stress physiology and brain function for self-regulation in children and parents: preliminary results

Eric Pakulak*, Theodore A. Bell, Ryan Giuliano, Melissa Gomsrud, Christina Karns, Scott Klein, Zayra Longoria, Lauren O’Neill, & Helen Neville

Brain Development Lab, Department of Psychology, University of Oregon, 1778 University of Oregon, Eugene, Oregon, 97403

Funding Acknowledgments: This research was made possible by Grant Number 90YR0076 from the Office of Planning, Research and Evaluation, Administration for Children and Families, U.S. Department of Health and Human Services.

*Corresponding Author:
Eric Pakulak
Department of Psychology
1227 University of Oregon
Eugene, OR 97403-1227
541-346-4892
pak@uoregon.edu
Recent calls to action emphasize the potential for two-generation approaches targeting foundational systems to improve outcomes for both children and parents in lower socioeconomic status backgrounds (Shonkoff, 2012). Based on information from basic research on the neuroplasticity of attention, stress and self-regulation, and family dynamics, and in partnership with Head Start of Lane County (HSOLC), we developed a successful two-generation intervention that targets attention by engaging the larger context of parents and the home environment. We have shown that this intervention improves brain function for attention, cognition, and behavior in preschool children in Head Start (HS) and also improves communication skills and reduces stress in parents (Neville et al., 2013). Here we present a preliminary case study focusing on the first year of implementation of a scalable delivery model of this intervention designed to be deliverable by HS specialists and replicable by other HS programs. This model was developed in close collaboration with HSOLC staff as part of a large-scale study funded by the Department of Health and Human Services, Administration for Children and Families. Additional goals of this study include a rigorous assessment of the hypothesis that children and parents randomly assigned to receive this intervention will demonstrate improvements in foundational systems (stress, self-regulation) as well as in outcomes relevant to parent and family well-being.

**Disparities related to socioeconomic status**

Before entering school, a child’s academic prospects can be predicted based on parental income, occupation, and level of education (i.e., SES; e.g., Duncan, Brooks-Gunn, & Klebanov, 1994). In addition to academic outcomes, disparities related to SES have been documented in children in specific cognitive skills, mental and emotional health, and specific aspects of brain
structure and function, as well as in outcomes into adulthood including cognition, health, educational attainment, and financial stability (for reviews, see Hackman, Farah, & Meaney, 2010; Raizada & Kishiyama, 2010; Yoshikawa, Aber, & Beardslee, 2012). These SES-related disparities are profound and have great economic costs (e.g., Heckman, 2006). As detailed below, two aspects of brain function that predominantly underlie these disparities are stress physiology and self-regulation. There is strong motivation to develop and implement evidence-based interventions that can narrow these achievement gaps (e.g., Heckman, 2006; Yoshikawa et al., 2012), and increasing recognition that interventions can be informed by research in cognitive science and cognitive neuroscience (e.g., Raizada & Kishiyama, 2010; Shonkoff, 2012).

**Stress and self-regulation**

Two aspects of brain function predominantly underlie SES-related disparities in educational and health outcomes related to well-being: stress physiology and self-regulation, which includes selective attention and executive function (e.g., Hackman et al., 2010; Shonkoff, 2012). Aspects of brain function related to these systems are foundational in that they are domain-general and thus related to multiple outcomes, including family well-being. In addition, evidence reviewed below suggests that stress and self-regulation are malleable in both adults and children.

**Stress**

While some exposure to normative or tolerable stress is an essential part of the development of a healthy stress response system, excessive and/or prolonged activation of the stress response system in the absence of supportive and responsive adult caregiving early in development creates a cumulative burden over time. This cumulative burden can result in physiological disruptions that lead to increased risk for a wide range of diseases in adulthood,
even in the absence of later behavior that threatens health outcomes: thus chronic stress in
development is characterized as “toxic” (for review, see McEwen & Gianaros, 2010).

**Stress, socioeconomic status, and student outcomes**

Decades of research indicate that children from lower SES backgrounds are more likely
to grow up in homes that are more stressful and less cognitively stimulating than their higher
SES peers (for reviews, see Hackman et al., 2010; Raizada & Kishiyama, 2010). Children in
lower SES homes often experience more chaotic living conditions (e.g., crowding, noise, family
instability) and more inconsistent and harsh disciplinary practices than their higher SES peers,
factors that have been shown to account for up to half of the academic disparity associated with
SES (e.g., Brooks-Gunn, Klebanov, & Liaw, 1995; Brown & Low, 2008). Also, poor sleep
habits have been linked to poor academic outcomes in children from lower SES backgrounds,
and family stress and inconsistency in the home environment have been hypothesized as
moderating factors in this relationship (Buckhalt, 2011). Higher levels of stress experienced by
lower SES children are reflected in more pronounced physiological markers of stress compared
to their higher SES peers (Obradovic, Bush, Stamperdahl, Adler, & Boyce, 2010), and this
relationship is partially mediated by family chaos (Chen, Cohen, & Miller, 2010). The role of
chaotic and stressful living conditions in children’s academic outcomes dovetails with an
emerging literature in neuroscience. Human and animal studies indicate adverse effects of stress
on brain development, particularly the prefrontal cortex and hippocampus, which are central to
many aspects of attention, working memory and executive function (for reviews, see Lupien,
McEwen, Gunnar, & Heim, 2009; McEwen & Gianaros, 2010). Animal models have shown that
early maternal nurturance influences brain development and that the effects of early nurturance
are pronounced on the stress response system, including projections to brain structures that are
central to learning, attention, and memory (e.g., Suomi, 2006). This suggests that stress chronically elevated by aspects of the home environment is one pathway through which brain development is compromised in children from lower SES backgrounds.

**Malleability of stress**

Although limited, evidence available to date suggests that stress physiology in children is malleable. An intervention targeted at supportive caregiving for foster children has been shown to reverse the blunted stress physiology (i.e., flattened cortisol response) typical of this population and others exposed to early adversity (Fisher, Stoolmiller, Gunnar, & Burraston, 2007). Similarly, a family-based intervention for children at high-risk for antisocial behaviors has been shown to normalize stress physiology in anticipation of a social challenge (Brotman et al., 2007), and this normalization was later linked to reductions in aggressive behavior with intervention (O’Neal & Brotman, 2010).

**Self-regulation (selective attention and executive function)**

Self-regulation is defined as primarily volitional regulation of attention, emotion, and executive functions for the purposes of goal-directed actions (Blair & Raver, 2012). In this project we are assessing self-regulation by measuring selective attention and executive function.

While models differ somewhat in their subdivisions and terminology of attention, all recognize the importance of a basic level of arousal and the importance of focused selection of specific stimuli for further processing, either transiently or in a sustained manner. Selective attentional selection includes processes of enhancing selected signals (signal enhancement) and suppressing irrelevant information (distractor suppression). Distractor suppression is a part of early selection and is also considered to be part of executive function.

Executive function (EF) subsumes a diverse set of psychological processes, including
core cognitive skills such as inhibitory control, working memory, and cognitive flexibility (e.g., Diamond, 2006). These skills emerge in infancy and undergo robust changes during childhood with marked improvements in EF skills observed especially between 3-5 years of age (e.g., Carlson, 2005; Diamond, 2006). The development of EF is important for adult outcomes, as self-control in childhood predicts health, substance dependence, personal finances, and criminal offending outcomes in adulthood (Moffitt et al., 2011).

Self-regulation, socioeconomic status, and student outcomes

Recent studies indicate that neural systems important for aspects of attention are particularly vulnerable in children from lower SES backgrounds (e.g., Kishiyama, Boyce, Jimenez, Perry, & Knight, 2009; Stevens, Lauinger, & Neville, 2009). We have shown that children from lower SES backgrounds display marked deficits in early (i.e., 100 msec) mechanisms of attention compared to children from higher SES backgrounds (Stevens et al., 2009). A large body of evidence shows that aspects of EF are particularly vulnerable in children from lower SES backgrounds (e.g., Noble, Norman, & Farah, 2005). These differences emerge as early as infancy for systems such as working memory and inhibitory control (Lipina, Martelli, Vuelta, & Colombo, 2005) and may persist into adulthood (Turrell et al., 2002).

It has been hypothesized that deficits in selective attention could have cascading consequences for later development and learning (e.g., Noble et al., 2005; Stevens & Bavelier, 2012). If a child struggles with attention and self-regulation, it may be difficult to select and focus on relevant information in classroom instruction. Several lines of evidence support this hypothesis. One study found that measures of attention and EF in preschool explained as much unique variance in early math and early literacy as a child’s IQ (Blair & Razza, 2007). In preschool children, a strong relationship is observed between EF skills and emergent
mathematical proficiency (Espy et al., 2004) and growth in emerging literacy and math skills (Welsh, Nix, Blair, Bierman, & Nelson, 2010). In addition, kindergarten teachers preferentially endorse prerequisite skills such as general classroom conduct and social-emotional competence, which are related to EF (Blair, 2002). This relationship extends beyond early years: for example, better EF skills observed in preschool years predict higher math and reading achievement three years later (Bull, Espy, & Wiebe, 2008). Therefore policy discussions of early school readiness often incorporate attention and self-regulation skills (NAEYC, 2009).

**Malleability of self-regulation**

As discussed above, the neural systems important for selective attention display considerable plasticity (e.g., Stevens, Fanning, Coch, Sanders, & Neville, 2008). We have shown that early (i.e., 100 msec) mechanisms of selective attention are enhanced in preschool children from lower SES backgrounds following participation in our intervention (Neville et al., 2013). While the malleability of EF in adulthood is an ongoing research question, some evidence suggests that aspects of EF may be malleable in adults. The prefrontal cortex, the brain region important for most aspects of EF, has a developmental timecourse extending into adulthood (Lupien et al., 2009). This suggests extended plasticity for brain systems underlying EF, and emerging research suggesting that aspects of EF can be improved with training in healthy adults is consistent with this observation (for review, see Guiney & Machado, 2013).

**Evidence-based intervention: Two-generation approaches**

Converging evidence from multiple fields of study, including cognitive neuroscience, education, and economics, suggests that one of the most promising approaches to ameliorating the SES-related achievement gap is via evidence-based interventions targeting children from lower SES backgrounds early in development (e.g., Heckman, 2006; Raizada & Kishiyama,
One approach is a two-generation model, in which services focused on improving children’s school readiness and long-term outcomes are combined with services focused on improving adult well-being. Studies initiated in the 1960s have shown that costly programs directed towards lower SES preschoolers and their parents ameliorate many of the short- and long-term deficits in at-risk children (Belfield, Nores, Barnett, & Schweinhart, 2006; Heckman, Moon, Pinto, Savelyev, & Yavitz, 2010). Studies of intensive home-visiting programs have shown that such programs improve cognitive and behavioral outcomes in children (e.g., Olds et al., 2004), and a review of international studies found interventions including parent involvement to have the strongest effects on child outcomes (Burger, 2010).

Increasingly, evidence suggests that it is necessary to consider the cumulative effects of poverty and the multiple risk factors and mediating mechanisms involved (e.g., McEwen & Gianaros, 2010; Shonkoff, 2012; Yoshikawa et al., 2012), including chronic stress (e.g., McEwen & Gianaros, 2010) and self-regulation (e.g., Blair & Raver, 2012; Raver et al., 2011). In a recent call for new approaches to address the problem of poverty-related disparities in health and development, Shonkoff (Shonkoff, 2012) conceptualizes the need to develop effective strategies for protecting children from the significant consequences of adversity, in particular chronic stress, in development. He argues that, in addition to targeting self-regulation in children, accumulating evidence “offers a new argument for a conceptually unified, two-generation framework for reducing the cycle of poverty by focusing on a core set of adult capabilities [executive function and self-regulation skills] that are essential prerequisites for success in both the home and the workplace” (pg. 17305). This is one hypothesis we are testing in this project: that our successful two-generation intervention has broad impacts on distal outcomes related to family well-being via the targeting of foundational systems.
Successful two-generation intervention in Head Start context

The intervention that is the focus of this project, Parents and Children Making Connections – Highlighting Attention (PCMC-A), was developed in a nine-year collaborative partnership with HSOLC. PCMC-A is rooted in basic research on neuroplasticity and began with the identification of self-regulation, and specifically sustained selective attention, as a candidate neurobiological target for intervention.

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 both vulnerable and enhanceable. Several studies report differences in aspects of attention in lower SES children (e.g., Noble et al., 2005), including reduced effects of selective attention on neural processing (e.g., Stevens et al., 2009). At the same time, attention skills are highly malleable, displaying improvements with training (e.g., Stevens et al., 2008). This raised the hypothesis that training programs for lower SES children that target the neural systems mediating selective attention would be a powerful means for improving other domains of cognition and academic outcomes for children from lower SES backgrounds. While several studies have examined the possibility of training different aspects of attention and domain-general cognitive processes in early to middle childhood (e.g., Rueda, Rothbart, McCandliss, Saccamanno, & Posner, 2005) using a single-generation approach that focused only on working with children, none took a two-generation approach. PCMC-A, described below, is a unique two-generation approach that targets stress and self-regulation. As discussed above, the home environment contains multiple pathways that may negatively impact the development of self-regulation, perhaps most importantly via the cumulative effects of chronic stress.

In the initial evaluation of PCMC-A we targeted typically developing, monolingual
children (N = 141) and their parents, all of whom were participants in HS and therefore from lower SES backgrounds. Families were randomly assigned to the training program, HS-alone, or an active control group. 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. Parents participating in the program reported reduced parenting stress and displayed improvements in specific aspects of language interactions with their children (Neville et al., 2013). PCMC-A employs two simultaneous approaches to improve children’s attention: a parent training program targeting family stress regulation principles and a child training program with instruction targeting attention and self-regulation, including emotional regulation.

The parent program of PCMC-A was adapted from Linking the Interests of Families and Teachers (LIFT), an evidence-based conduct disorder prevention program for elementary-aged students (Reid, Eddy, Fetrow, & Stoolmiller, 1999). PCMC-A includes five core components from the adapted LIFT intervention: (1) **Contingency-based home discipline** (e.g., time-out, privilege removal); (2) **Positive involvement** (e.g., specific praise); (3) **Skill encouragement** (e.g., breaking behavior into small steps, praise and incentives); (4) **Problem-solving**; and (5) **Monitoring and supervision.** In addition, the parent program of PCMC-A includes four core components unique to PCMC-A: (1) **Age-appropriate communication** encourages parents to engage their child using clear and meaningful statements and requests, and to use pictures to supplement communication; (2) **Emotional regulation** promotes awareness of the child’s emotional states (e.g., emotional saturation) and provides strategies to support the child’s developing emotional regulation skills; (3) **Managing family stress** provides strategies to help parents prevent, manage, and reduce stress in the household (e.g., the creation of predictable
home environments, awareness and avoidance of power struggles) and also includes lessons on the impact of chronic stress on brain development; and (4) Supporting child attention and self-regulation encouraged parents to support the child’s emerging attention and self-regulation skills via strategies (e.g., giving the child opportunities to make choices and solve problems in a variety of situations) and via the sharing of strategies and materials from child attention training activities to facilitate generalization in the home.

The child training program employs evidence-based activities developed by an experienced teacher with input from HSOLC specialists. The program is structured around five core components: (1) Positive social interaction involves practicing of appropriate and positive interactions with others to support the child’s developing social skills; (2) Metacognitive awareness involves exercises to build the child’s awareness of different cognitive and emotional states, emphasizing emotional vocabulary to support emotional regulation development; (3) Self-regulation involves practice with self-directed strategies (e.g., deep breathing, self-redirection) to manage the response to typical preschool stressors (e.g., delay of gratification, emotional saturation); (4) Focused attention involves auditory, visual, and kinesthetic exercises that naturally engage children so they experience and practice sustained focus on an attended stimulus; and (5) Dealing with distraction complements and builds upon the focused attention component fun exercises to practice managing realistic classroom distractions.

**Scalable delivery model of PCMC-A**

The primary outcome of the project to date is a scalable delivery model of PCMC-A, developed in close collaboration with HSOLC staff. This model maintains fidelity to the core instructional components of PCMC-A as described above while incorporating modifications designed to make the intervention more readily deliverable by HS staff and thus more sustainable.
long-term. To this end, we first changed the name of the program, from PCMC-A to Creating Connections: Strong Families, Strong Brains (henceforth CC). In our previous studies, participants found the PCMC-A acronym unwieldy and rarely used it, so we decided it was important to facilitate integration into HS and recruitment to adopt a more “user-friendly” name. We also hired a graphic designer to design a unique logo to convey visually the core elements of CC: stars, representing neurons, in a silhouette of a child’s head which is inside a silhouette of a house, representing the importance of parents and the home environment. Below we detail modifications to the child and parent components of the intervention, respectively.

Child component

The child component of CC, “Brain Train,” is integrated into the regular HS classroom and therefore implemented throughout the school year. This is in contrast to the child component of PCMC-A, which was delivered in eight 50-minute sessions, in a different room but at the same time as the parent component. In addition, CC also involves the integration of selected strategies from the parent component into the classroom. These strategies primarily focus on stress reduction, behavior management, and support of the child’s emerging attention and self-regulation skills. One rationale for the integration of parent strategies into the classroom is that children will develop a familiarity with the strategies such that when parents begin to employ them at home this will improve the level of consistency between the class and home environment. We hypothesize that this increase in consistency and predictability across multiple environments will reduce stress for the child. Another rationale is that, as teachers enjoy success with the strategies in the classroom, this will allow them to provide first-person descriptions when encouraging parents to attend the parent component meetings.

Teacher training is integrated into the existing HS training format, with primary training
on teacher inservice days at the beginning of the school year and approximately six weeks into
the school year and a follow-up training session approximately halfway through the school year.
Training sessions employ an interactive format in which both child component activities and
parent strategies are introduced and then practiced in small-group and role-play activities. All
teachers receive a reference manual with descriptions of all child component activities and parent
strategies as well as a plastic tub with all materials necessary for classroom activities
(subsequently delivered to the classroom). An online support system for teachers is also
introduced; this system, delivered via a platform called Obaverse, includes electronic copies of
all materials in the reference manual, video examples of all activities and strategies, and links to
ask questions and request feedback from our interventionists.

In addition to the Obaverse online support system, teacher support is provided via
periodic classroom visits by our interventionists. These visits consist of classroom observations
of the child component activities and parent strategies, followed by immediate in-person
feedback.

**Parent component**

The parent component of CC maintains the format employed in PCMC-A: nine weekly
two-hour meetings (one introduction, eight instructional). This nine-week session occurs once
over the school year during the winter. Maintaining this format permits two laboratory data
acquisition periods that do not overlap with delivery of the parent component: fall pre-testing
and spring post-testing. This format also provides time in the fall to implement multiple
strategies for parent recruitment.

Because the small-group format of PCMC-A (i.e., caregivers of 4-6 children) is not
sustainable given HS resource limitations, the primary modification to the parent component is in
the size of the parent component meetings. The component is now delivered in a format designed to accommodate up to 30 caregivers with a combination of large-group curriculum instruction and small-group discussion and role playing. To accommodate this change, and to improve the sustainability of the model, CC parent component meetings involve multiple HSOLC co-facilitators who facilitate the small-group discussion following large-group instruction by one of our interventionists. This model also allows selected HSOLC co-facilitators to transition over time to a role as lead interventionist, thereby improving long-term sustainability. Four different meeting times, on different days and at different times of day, are made available to accommodate variable parent schedules. As in our previous intervention research, we provide food and childcare for all parents who attend.

Co-facilitators are recruited broadly from within HSOLC and are primarily teachers, assistant teachers, and family service coordinators. Training is provided in a single full-day training in January, with a half-day follow-up training occurring approximately halfway through the nine-week schedule. Feedback is provided by our interventionists immediately following each meeting, and co-facilitators also have access to the Obaverse online support system, where they can submit questions to our interventionists at any time.

**Assessment of Creating Connections**

As detailed below, we hypothesize that children and parents randomly assigned to receive CC will demonstrate improvements in foundational systems (i.e., stress and self-regulation) as well as in outcomes relevant to parent and family well-being. To test these hypotheses, we have expanded our battery of outcome measures of family stress and self-regulation from that used in our previous study (Neville et al., 2013). Laboratory measures are acquired during a three-month period in the fall before the nine-week parent component session described above, and
again during another three-month period in the spring following the session.

Brain function for self-regulation and stress physiology

To measure brain function for selective attention and self-regulation in children and adults, we employ event-related brain potential (ERP) measures. ERPs provide an online, multidimensional index of cognitive processes with a temporal resolution of milliseconds (msec) and are thus a widely used methodology to examine online brain function, in particular in young children. To measure brain function for selective attention, we are employing the paradigm we have used successfully with both child and adult participants. Briefly, participants selectively attend to one of two simultaneously presented stories and the effects of selective attention are quantified by comparing the brain response to probes embedded in the attended story with the response to identical probes embedded in the unattended story. In adults, we are also measuring brain function for inhibitory control employing a stop-signal task (Berkman, Kahn, & Merchant, 2014). In this task, participants are instructed to press a response button as quickly as possible following a visual cue but must withhold this response following occasional auditory stop cues.

To assess stress physiology in children and parents, we are acquiring measures of heart rate variability, which has been found to be a robust biomarker of individual differences in stress physiology (e.g., Hemingway et al., 2005). Electrophysiological recordings of cardiovascular activity are acquired simultaneously with our measures of brain function, thus capturing the dynamic interaction between heart and brain (e.g., Thayer & Lane, 2009). In children, we are also acquiring stress physiology data during an inhibitory control task in which the child is instructed to remain still in front of a cup of candies for four minutes during a series of distractors (Kochanska, Murray, Jacques, Koenig, & Vandegeest, 1996).
Additional laboratory measures

In addition to the measures described above, we are also acquiring standardized measures of language and nonverbal IQ in children, parent self-report measures of parenting stress and child behavior, and a videotaped child-parent play dyad that is subsequently coded for parent language behavior.

Parent and family well-being

To test the hypothesis that participation in CC might result in broader outcomes related to parent health and well-being, we will acquire additional data one year after the intervention period. These data include questionnaire assessments of the home environment (CHAOS scale; Dumas et al., 2005) and child sleep habits (Tayside Children’s Sleep Questionnaire; McGreavey, Donnan, Pagliari, & Sullivan, 2005) as well as objective measures of health including cardiovascular, immune, and metabolic function. In addition to laboratory assessments, we will also analyze data collected by HSOLC at the beginning and end of each school year from all families. These measures include evaluations of parental education attainment and goals, employment, financial literacy and stability, community connections/support, health and safety, including access to health care, housing, and child care.

Data acquisition and analysis

Seven HSOLC sites participated in the first year of implementation; four were randomly assigned to implement CC as described above, and three were randomly assigned to be comparison sites implementing HS curriculum as usual. In the first year of implementation and assessment, we successfully acquired pre- and post-intervention period from a total of 77 participants: 48 from CC sites and 29 from comparison sites. Analysis of measures of stress physiology and brain function is time- and resource-intensive and is ongoing at this time.
Case study of first year of implementation: guiding questions

The 2014-15 school year was the first year of implementation of the delivery model described above. Creating Connections was implemented in four randomly-assigned HSOLC sites consisting of a total of 10 classrooms serving approximately 170 children. Several guiding questions will be used to provide a case study of this implementation.

(1) At what rates do parents (and Head Start staff) take up the program and what are their goals and motivation for participation?

HSOLC staff

As expected, we experienced variability in the degree of enthusiasm for the project from teachers as well as in the degree of implementation. We set a goal for teachers of engaging in at least one child component activity per week, and while many teachers exceeded this over the course of the school year, several failed to meet this goal. A primary contributing factor was that the first year of implementation coincided with the introduction of a mandatory new system for online child assessment; many teachers reported feeling overburdened by the CC implementation as they were simultaneously learning this new system. We also encountered difficulty in the assessment of CC implementation; in addition to the classroom fidelity observations described above, we also planned to make use of weekly lesson plans but encountered variability in the degree to which teachers completed and/or shared these lesson plans.

We also noted that enthusiasm and implementation improved over the course of the school year, and we held a gathering for all participating HSOLC staff at the end of the year to obtain feedback. We received feedback on numerous aspects of implementation, including which activities and strategies required more training and support, the timing and format of
training sessions, and suggestions for how to better integrate the assessment of the implementation of child component activities into the existing HSOLC assessment infrastructure. We have made numerous changes based on this feedback and, while it is still early in the second year of implementation, it appears as though teacher enthusiasm is greater than last year.

An aspect of HSOLC staff participation that exceeded our expectations involved recruitment for co-facilitator positions for the parent groups. There was greater interest in this role than we anticipated, and the group of co-facilitators was enthusiastic and engaged throughout the co-facilitator training and implementation of parent groups even though the attendance at those groups was lower than anticipated (see below).

There was also variability in the goals and motivation for participation. Teachers who showed the least enthusiasm typically reported participating primarily because it was required, but most teachers expressed excitement at participating in a research study. This was likely due in part to our existing positive and longstanding relationship with HSOLC; as described above, our intervention was the result of a nine-year collaboration. Many teachers at CC sites were familiar with our research and this collaboration and were pleased to have the opportunity to participate. They also expressed an appreciation that this research has the potential to provide scientific evidence with the potential to improve HS and outcomes for the children they teach. Most of the HSOLC staff who took on co-facilitator roles expressed interest in parenting programs broadly and enthusiasm for the opportunity to be directly involved.

Parents

Despite multiple recruitment strategies that focused on making contact with parents “early and often” and that employed flyers, in-person contact, phone reminders, and materials sent home with children, parent engagement in CC was much lower than anticipated. Of
approximately 170 children across CC sites, 26 parents consistently attended the nine-week parent component meetings. The parents who did consistently participate expressed a desire to learn more about how they can improve their parenting skills and help their children. Additionally, consistent with our previous intervention work, several parents noted that their success with some of the initial parent strategies presented provided motivation to return and build on these strategies.

Based on feedback from multiple sources, including our HSOLC partners, we changed our approach to parent recruitment for the second year of implementation. The primary focus of this new strategy involves increasing the degree to which CC broadly, and the parent component specifically, is integrated into HS and therefore viewed by parents as a natural part of the services provided by HS sites implementing CC. To this end, the parent component is now framed with an “opt-out” approach that is conveyed by HS staff during initial intake and registration. In the context of other HS expectations of parents (e.g., maintaining levels of child attendance, attending parent-teacher conferences, hosting a home visit by HS staff), the parent component is introduced as something exciting happening at that HS site and parents are asked to sign-up for a specific day and time upon registration. While it is early in the second year of implementation, thus far it appears as though this change in approach is proving successful; to date, 169 parents (of approximately 340 children) have signed up for a parent component meeting. We are continuing the recruitment and sign-up process while implementing multiple strategies for reminding parents, and teachers and other HS staff are more involved in this process than in the first year of implementation.
(2) What are the unique strengths of the intervention model and its implementation in Head Start centers?

Our intervention is unique in that it is rooted in basic research on neuroplasticity and that we are assessing the degree to which participation in CC improves specific aspects of stress physiology and brain function for attention and self-regulation as described above. This approach will provide unique evidence on the mechanisms by which two-generations impact both children and parents.

Another unique strength of the intervention, and especially of the delivery model described here, is the degree of integration between the child and parent components. As described above, by implementing parent strategies in the classroom that are subsequently provided to parents, we are greatly improving integration between the class and home environment. As described above, we hypothesize that this consistency will result in reductions in child stress and also that it will provide a model for improving parent participation in the parent component.

This delivery model also retains, and improves upon, another aspect of integration. In both models, the parent component includes discussion of child component activities and the sharing of materials to facilitate practice in the home environment. In CC we anticipate that this integration will be improved due to the participation of HSOLC staff; because teachers are implementing the child component in the classroom this will afford multiple opportunities to relate success stories about the child activities and encourage home practice. In addition to potentially improving outcomes, we also hypothesize that this overall improved integration, and increased involvement and knowledge of HS staff in all aspects of CC, will result in a model that is more sustainable.
(3) What are the distinct challenges and tensions in implementing a two-generation program for the families of Head Start?

Consistent with the literature and with our previous experience in this line of research, to date the greatest challenge in this project has been parent recruitment. As discussed above, despite extensive efforts across multiple avenues of recruiting we fell short of our recruitment goals for the parent component in the first year of implementation. Parents served by HS are by definition living in poverty, and many have chaotic and busy lives that often involve variable work schedules that can make regular attendance at parent component meetings difficult. Providing multiple meeting days and times, as we are, is preferable but also presents logistic challenges in finding times that accommodate the most parents as well as in providing staffing, childcare, and food for parents. In addition to providing food and childcare, evidence suggests that financial incentives can improve parent attendance (e.g., Heinrichs, 2006), but it can be prohibitively expensive to provide financial incentives with large-scale implementation. As discussed above, we are hopeful that the changes to our recruitment strategy that improve the degree to which parents view the parent component as a natural part of HS services and that improve the involvement of HS staff in parent recruitment will improve parent participation in the second year of implementation; still, we acknowledge that such strategies do not adequately address all of the challenges described above.

(4) What are the potential benefits for current and future Head Start participants and their parents?

Potential benefits for current HS participants and parents are best described in terms of our hypothesized outcomes in multiple domains. As discussed above, one emerging theme in the literature on evidence-based intervention is that two-generation programs targeting foundational
systems such as stress and self-regulation might have impacts beyond the improvement of school readiness and other outcomes in children. Specifically, one hypothesis is that interventions that improve the caregiving environment by improving self-regulation skills in parents will strengthen the economic and social stability of the family in numerous ways, for example by enhancing the employability of parents by improving these foundational skills (Shonkoff, 2012).

In addition to changes in parenting stress and language behavior in parents reported in (Neville et al., 2013), this hypothesis is supported by specific aspects of the parent component of our intervention. Many of the specific strategies ask parents to engage skills related to self-regulation and executive functioning (EF). Parent strategies focus on monitoring and changing language use with children, facilitating more consistency in routines and contingency-based discipline, and strengthening positive relationships with their children. Improvements in structure and predictability are supported by strategies employing “success charts,” which require increasing degrees of planning and consistency on the part of the parents as they use picture-based schedules with their children. These schedules are then used on increasing time scales (e.g., morning, day, week) in ways that involve greater use of rewards and delays of gratification. Aspects of EF related to thoughtful planning for the future are directly emphasized.

As a precursor to many of these strategies, a metaphor is used that encourages parents to appreciate the benefits of greater awareness of the future consequences of their actions: parents are encouraged to become more “planful” in their thinking and behavior with their children. Each of these techniques requires parents to increase their self-awareness, engage aspects of EF to monitor their everyday actions, and control their emotions in daily interactions with their children to avoid power struggles and cultivate and maintain a less stressful home environment.

The relationship between core components of the intervention and hypothesized
outcomes is illustrated in the theory of change model presented in Figure 1. The core components of the intervention are hypothesized to impact targeted processes related to stress and self-regulation via multiple pathways in both parents and children. Core components of the parent training program target stress and self-regulation via facilitation of consistency in routines and contingency-based discipline, strengthening positive relationships with children, and the support of emerging stress regulation and attention/self-regulation skills in children by encouraging and supporting child cognition and problem solving. Core components of the child component target these hypothesized mechanisms via exercises specifically designed to improve self-regulation, focused attention, and child metacognitive awareness and regulation of stress/emotion, all of which are supported in the parent program by sharing exercises with parents and encouraging them to practice at home with their children. We hypothesize that we will replicate changes in child outcomes important for school readiness (brain function for attention, nonverbal IQ, receptive language), and that we will in addition document changes in hypothesized mediating outcomes, stress physiology and self-regulation in parents. We also hypothesize that changes in the proximal outcomes described above will be accompanied by changes in stress physiology in the children themselves. We hypothesize that changes in stress physiology and self-regulation in parents after participation in CC will in turn result in changes in the longer-term distal outcome measures we propose, all of which are specifically related to family well-being in the areas of health, education, and financial security.

There are several potential benefits for future HS participants and their parents. First, positive evidence supporting the hypotheses described above could inform public policy decisions regarding investments in early education. Specifically, such positive evidence would support increased investment in two-generation programs and thereby provide the necessary
financial resources to implement such programs more broadly across HS. Second, this project will result in a delivery model that has been developed and refined across many years in close collaboration with HS staff. This should result in a model for training and implementation that is realistically sustainable across HS.

**Conclusion and future directions**

The preliminary case study presented here demonstrates the feasibility of implementing a scaled-up delivery model of a successful two-generation intervention in a HS context. Ongoing work will refine and improve the implementation, primarily via our productive and collaborative relationship with HSOLC staff. We also continue to acquire and analyze data to evaluate the hypotheses outlined above. Should our hypotheses be upheld, the results would be consistent with existing evidence that intensive programs for children from lower SES backgrounds can ameliorate many of the short- and long-term deficits in at-risk children and are therefore good investments with broad benefits to society and high rates of return (e.g., Belfield et al., 2006; Heckman et al., 2010). Working with our colleagues in the University of Oregon Department of Economics, we previously conducted a preliminary benefit-cost analysis of PCMC-A that yielded a similarly high return on investment (Pierce, 2009). One important future direction for the research described here will be to employ the results from this project to inform a refined benefit-cost analysis of Creating Connections. Results from such analyses have the potential to improve the degree to which this research can inform and impact public policy decisions regarding investments in early education.
References


25


Figure 1. Theory of change model for Creating Connections.

Theory of change model: Creating Connections

Intervention Components
- Positive involvement
- Age appropriate communication
- Emotional regulation
- Skill encouragement
- Contingency-based home discipline
- Supporting child cognition
- Family stress & problem solving
- Monitoring & supervision

Targeted Processes
- Parent
  - Family relationships
  - Caregiver language & communication
  - Consistency/predictability
  - Caregiver stress
  - Caregiver emotion regulation & modeling
  - Caregiver planfulness & awareness
- Child
  - Family relationships
  - Child language & communication
  - Self & emotional regulation
  - Child stress
  - Attention regulation

Proximal Outcomes
- Caregiver stress: LSI
  - Stress physiology: HRV
- ERPs: Selective attention, inhibitory control
- Caregiver-child interactions: parent language behavior
- Stress physiology: HRV
- ERPs: Selective attention
- Child problem behaviors
- Behavioral tests: language, IQ, executive function

Key mechanisms
- Stress
- Self-regulation

Projected Distal Outcomes
- Health and safety: HSOLOC survey, Child Sleep Questionnaire
- Physical health: Blood pressure, immune system indices, metabolic indices, BMI
- Financial literacy and stability: HSOLOC survey
- Educational goals and attainment: HSOLOC survey
- Household chaos: CHAOS scale

Child component
- Positive social interaction exercises & modeling
- Self-regulation exercises & modeling
- Focused attention exercises & modeling
- Dealing with distraction: exercises & modeling
- Child metacognitive awareness

Parent component
- Monitoring & supervision