



Promoting Healthy Child Development via a Two-Generation Translational Neuroscience Framework: The Filming Interactions to Nurture Development Video Coaching Program

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ABSTRACT—*In this article, we focus on applying methods of translational neuroscience to two-generation, family-based interventions. In recent years, a small but growing body of evidence has documented the reversibility of some of the neurobiological effects of early adversity in the context of environmental early interventions. Some of these interventions are now being implemented at scale, which may help reduce disparities in the face of early life stress. Further progress may occur by extending these efforts to two-generation models that target caregivers' capabilities to improve children's outcomes. In this article, we describe the content and processes of the Filming Interactions to Nurture Development (FIND) video coaching intervention. We also discuss the two-generation, translational neuroscience framework on which FIND is based, and how similar approaches can be developed and scaled to mitigate the effects of adversity.*

KEYWORDS—parenting; video coaching; neuroscience

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Historically, most research on the neurobiology of stress has focused on documenting the negative effects of early adversity on the developing brain and other stress-sensitive systems. This work has emphasized the effects of disrupted caregiving in infancy and early childhood, a time of particular vulnerability. For example, studies of rodents and nonhuman primates have investigated the effects of offspring being separated from mothers (1), being raised by peers (2), and being handled by researchers early in life (3). These stressors (and others) disrupt parental care when offspring depend on it, altering biobehavioral development. One of the main areas of investigation of this topic has been alterations in the functioning of the hypothalamic–pituitary–adrenal (HPA) axis, a regulatory system that helps maintain homeostatic balance in the face of stressors. In addition, researchers have reported disruptions following early adversity in the functioning of the immune system, metabolic function, and numerous areas of the brain—with lifelong consequences for health and well-being (4). Similar neurobiological effects of early adversity have also been documented in humans for whom care was disrupted by neglect and traumatic stressors (5).

Research on the neurobiology of stress has generated attention from the media and stimulated public interest, leading to popularization of the concept of toxic stress (6). However, scientific knowledge in this area has rarely led to intervention strategies to mitigate the effects of early adversity. Relatedly, public-policy efforts and evidence-based programs designed to reduce population-level (or even community-level) disparities among individuals exposed to high adversity have produced only modest impacts. Indeed, consistent federal and state funding for social programs aimed at addressing these concerns, dating to the 1960s, has done little to mitigate the effects of toxic stress at the societal level, especially among those exposed to the greatest adversity (7).

In recent years, a small but growing body of evidence has documented that environmental early interventions can reverse some neurobiological effects of early adversity. Initial studies with animals (8) used enriched environment paradigms, providing enhanced cognitive and physical stimulation to rodents who were stressed prenatally. In subsequent research with humans, researchers documented that systematic changes in the environment, particularly in patterns of caregiving, could normalize some areas of brain function. For example, in the Bucharest Early Intervention Project, children who had been institutionalized and were randomly assigned to foster care in early childhood had improved cognitive function (9) and more typical levels of electrical activity in the brain (10). In other intervention studies, infants and preschoolers in foster care (11, 12) and economically disadvantaged children (13) had positive changes in salivary cortisol levels (the hormonal product of HPA axis activity). In other studies, when high-risk children participated in programs designed to promote self-regulation and readiness for school, their brain activity changed in regions associated with monitoring responses (e.g., the prefrontal cortex; 14, 15). Similarly, in studies using behavioral measures associated with key areas of brain functioning, children enrolled in school-readiness programs improved relative to their peers who did not participate in such programs (16, 17). Finally, in a recent study, adults who had taken part as children in a family-based intervention had significantly lower levels of blood-based markers of chronic inflammation, which are associated with risk for autoimmune and rheumatoid diseases (18).

These studies contribute to the literature from both a science and a policy perspective, telling us that the effects of early stress are not irreversible (19). Moreover, as the interventions in these studies show efficacy and move toward implementation at scale, they can incrementally reduce the effects of adversity on the health of those who are exposed to early life adversity. Nevertheless, among these studies, neurobiological measures have been used primarily with behavioral measures as indicators of children's outcomes. Absent are theory-driven interventions that use translational neuroscience (20) to consider how family-based interventions might affect the underlying capabilities of caregivers, which, in turn, influence children's outcomes. Such research is needed given the potential of two-generation models (i.e., those whose theory of change includes targeting specific processes in *both* parents and children) to improve outcomes for disadvantaged groups (7, 21).

Applying translational neuroscience to two-generation intervention models can move the field forward in four ways. First, it helps us identify underlying neural systems in caregivers that may mediate or moderate pathways among children's early adversity, caregiving practices, and subsequent psychosocial adjustment. Second, it allows us to develop new intervention programs that can mitigate the effects of early adversity and determine whether changes in specific neurobiological systems in adults are the mechanisms by which interventions work.

Third, it allows us to identify and change core capabilities (e.g., executive functioning) in adults that may underlie not only effective parenting but also family and personal goal setting, economic self-sufficiency, mental health, and other important outcomes. Fourth, it helps us identify common targets across different intervention strategies and programs, supporting the aggregation of knowledge in the field.

In the following section, we describe a scalable video coaching program designed to be used when children are infants and in early childhood, and that is based on a two-generational, translational neuroscience framework. We present an overview of the program and its distinguishing characteristics, describe its conceptual model, and discuss how the program is informed by an understanding of the core adult neurocognitive processes the intervention is designed to strengthen. We also address how the program can generate testable neuroscience hypotheses about caregivers' capacities that take the bidirectional exchange between theory development and applied research beyond what could be accomplished by two-generation developmental science paradigms alone.

THE FILMING INTERACTIONS TO NURTURE DEVELOPMENT PROGRAM

Filming Interactions to Nurture Development (FIND) is a brief video coaching program for parents and other caregivers. FIND is designed to promote naturally occurring, developmentally supportive interactions between infants and young children and the significant adults in their lives. Drawing on emerging knowledge on the developmental neuroscience of early adversity (6), the intervention is rooted in microsocio interaction research at the Oregon Social Learning Center (22), as well as in the Marte Meo video coaching intervention, which has been implemented widely in Europe and elsewhere (23). FIND shares many features with attachment research that underscore the importance of reciprocal interactions (24, 25) and attachment-based interventions, such as the Video-Feedback Intervention to Promote Positive Parenting (26) and the Attachment and Biobehavioral Catch-Up program (27), which use video coaching while enhancing developmentally supportive, responsive caregiving.

Like other two-generation video coaching programs, FIND targets interactions between children and their caregivers in the early years, when basic brain circuitry is being established for language, socioemotional, cognitive, and self-regulatory capacities. During these early years, the brain more than doubles in size, yet its maturation depends on experience. Developmental neuroscience suggests that experiences central to infants' brain development are embedded in the relationship between infants and children and their caregivers; although infants are born genetically programmed to connect with caregivers, only within the context of attuned, reciprocal, and well-regulated interactions do genes have the possibility of being carried forth to promote sufficient brain growth (28).

Therefore, FIND focuses on enhancing patterns of infant-caregiver interaction known as “serve and return” interactions. From the perspective of behavioral research, these patterns comprise attuned, reciprocal, and well-regulated interactions, and from the perspective of developmental neuroscience, they promote optimal growth and development of the infant brain. The serve and return metaphor describes attentive, responsive caregiving in easy-to-understand terms for widespread dissemination. Children naturally serve when they initiate interaction through gaze, vocalization, and action; adults return the serve when they respond in developmentally supportive ways.

Consistent with meta-analyses that suggest that less is more when it comes to the length of video coaching interventions (29), FIND is brief, typically taking place over 10 weekly meetings that alternate between video recording sessions and coaching sessions. Between recording and coaching sessions, videos are edited (by a coach or editor) to show brief clips during which the caregiver and child are engaged in serve and return interactions. The edited film is designed to facilitate learning and optimize caregivers’ engagement; it features two still-frame photos (one at the beginning and one at the end) that flank three video clips. Each clip begins with a brief text description of the interaction and is viewed by the coach and the caregiver three times in immediate succession. During the second viewing, the coach provides a frame-by-frame analysis of the serve and return element. The video review is descriptive, but uses precise techniques and language that distinguish FIND from other video coaching programs. These techniques maximize the salience of the serve and return element to the caregiver, reduce reliance on professional and paraprofessional expertise, and facilitate fidelity

of implementation. In addition, editing, coaching, and consultation can be done by one organization; alternatively, if an implementing organization lacks the resources or expertise to complete editing or consulting, these can be managed by a centralized FIND hub (typically based in a large social-service organization or university) where all videos can be uploaded to a server, edited by a centralized team, and returned to coaches in the field who may also receive consultation on the coaching process from the experts at the hub. This helps maximize the program’s scalability.

FIND’S CONCEPTUAL MODEL

The conceptual model for FIND specifies caregiver-based targets of intervention and outcomes in the caregiver and child (see Figure 1). It also details underlying neurocognitive capacities in the caregiver that are hypothesized to mediate the associations between targets and outcomes. Studies to evaluate the validity of this model through randomized clinical trials are under way.

TARGETS

The FIND intervention comprises five elements of serve and return, which are described in precise behavioral terms. An adult *shares the child’s focus* when he or she notices what the child is focused on (i.e., the child’s serve) and shows interest in that object, activity, or experience. The adult can then respond by *supporting and encouraging* or by *naming*. Supportive responses include offering help, offering comfort, or providing something the child needs. Encouragement consists of praise

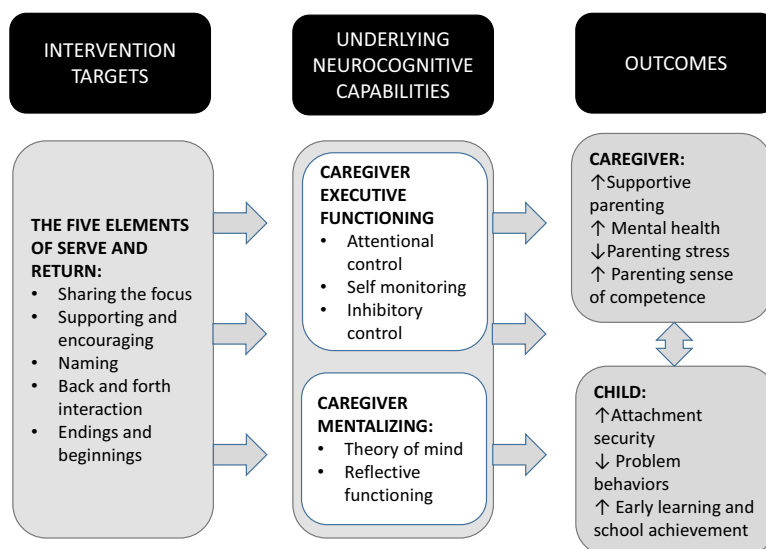


Figure 1. Conceptual model for Filming Interactions to Nurture Development that depicts the associations among intervention targets, underlying neurocognitive capacities, and outcomes.

Note. In the outcomes listed, up arrows depict improvements in a domain and down arrows depict decreases in a domain.

and acknowledgment. *Naming* occurs when the adult gives the child a word for what the child is seeing, doing, or feeling. *Back and forth interaction* is a natural extension of the serve and return process that takes place when the adult notices the serve, responds, and then waits for the child's further initiations. This leads to a sustained, reciprocal interaction. The last element, *endings and beginnings*, happens when one *back and forth interaction* comes to an end and another begins.

OUTCOMES

Like other two-generational programs, FIND is hypothesized to decrease parenting-related stress and improve caregiving competence. However, the FIND program differs from more traditional interventions that teach parents what they should do differently or highlight areas they need to improve. In at-risk families, focusing on parenting deficits may evoke feelings of failure, thereby inducing or exacerbating mental health problems (e.g., symptoms of depression, substance use; 30). This may lead parents to disengage from or drop out of treatment, and it can have unintended negative effects, such as decreasing parents' sense of competence. By contrast, consistent with other strengths-based models (31), FIND aims to increase caregivers' beliefs that they are or can become good parents and that, despite any difficulties they experience, they have innate parenting capacities and know how to support their children.

We expect that when parents and caregivers take part in FIND, their parenting and well-being will improve, and that these improvements will co-occur with improvements in children's outcomes across many domains, including more secure attachment, decreased problem behaviors, and more optimal early learning and school achievement. Responsive parenting has also been associated with improvements in children's behavior (32). Thus, we expect that after participating in the FIND program, children will have lower rates of internalizing and externalizing behaviors. FIND is also designed to promote early learning and contribute to children's early academic achievement (33). The emphasis on naming objects, people, and feelings that the child is oriented to is intended to directly improve children's vocabulary development and increase their comprehension of verbal communication.

MEDIATORS

In the FIND conceptual model, targeted behavioral training is hypothesized to affect several cognitive capacities and associated neural substrates in caregivers. These in turn are thought to mediate a cascade of effects in the caregivers, the children, and the caregiver-child dyads. We also expect that FIND will modulate underlying capacities in caregivers, including executive function and mentalizing domains.

Executive function is related closely to emotion regulation (34), and both capacities are critical in developing and maintaining parenting practices (35). Moreover, cognitive control capacities are important for parents dealing with stressful

contextual factors, such as low socioeconomic status and adverse events (36). Generally, low levels of maternal emotion and cognitive control capacity are associated with increased risk of maltreating children, while higher levels of maternal emotion and cognitive regulation are associated with more sensitive, involved parenting (37). Cognitive regulatory capacities are thought to underlie caregivers' abilities to be perceptive, responsive, and flexible (38). Caregivers use these capacities extensively in interactions with their children to plan and flexibly change their behaviors when necessary, respond appropriately to children's cues, and regulate their own emotions in the face of challenging behaviors by their children (38, 39).

Neuroscience research delineates the neural substrates of executive function and emotion regulation, pointing toward two complementary but interconnected neural systems: the ventral system and the dorsal system (see 40 for a review). In addition, researchers have begun to evaluate the neural circuitry of human parenting and parents' responsiveness to infants' affective cues (41, 42). The multimodal integration of data from behavioral and neuroscience research is central to the FIND conceptual model and may be necessary to advance the field beyond what could be accomplished with behavioral research alone. This is relevant for differentiating underlying neural substrates (e.g., underreactivity vs. overreactivity to children's emotions) that produce identical behavior in caregivers (e.g., avoidance, child neglect).

With regard to behavioral and neuroscience research, caregiver behaviors targeted in the FIND intervention are hypothesized to modulate the following executive function and cognitive control capacities and their associated neural substrates:

1. **Attentional control:** Caregivers are instructed to "notice" children's cues and "share the children's focus." In doing so, caregivers practice deliberately, flexibly shifting attention toward the children in response to the children's cues. The salience and attentional capture of children's cues may be enhanced by reinforcement from the coach that emphasizes the importance of sensitivity to children's cues. Positive interactions from successful sharing of attention are inherently rewarding and thus further reinforce heightened salience and attentional capture of infants' and children's cues.
2. **Self-monitoring:** Through the FIND program, caregivers grow used to viewing themselves on videotape while interacting with their children. Caregivers are directed to reflect on their positive behavioral responses during the interaction, eliciting increased self-monitoring of their own behaviors during the interaction.
3. **Inhibitory control:** Caregivers are instructed to wait for children's cues ("serve"), allowing children to take the lead. After responding to children's initial cues, caregivers are again instructed to wait for the following cue, allowing the children to reciprocate and facilitating an ongoing exchange with consecutive turns ("back and forth"). Waiting for children's serve requires caregivers to practice inhibition while

withholding prepotent response; such response inhibition may necessitate emotion regulation in the context of children's distress.

Changes in each of these domains for parents are expected to be supported by underlying neural processes governing early stages of initial perceptual processing of their infant, and attentional engagement and in-depth cognitive evaluation of these stimuli. Neuroimaging studies indicate that several processes may come into play. First, increases in activity in adults' limbic systems (from which emotions arise) may increase their perceptual sensitivity to emotional cues from the infants. Second, top-down cognitive control from areas of the brain involved in executive functioning (specifically the anterior cingulate cortex) may help parents regulate their own emotions more effectively, allowing increased ability to process infants' cues and appraise their emotions (see 40 for a review).

FIND is also hypothesized to act via changes in theory of mind and reflective functioning, as caregivers come to perceive infant "serves" as cues. Both capabilities are domains of mentalizing, or the ability of an individual to hold the mind of others in mind, and attribute an underlying mental state and intentional stance to others' behavior (43). Relevant neural substrates associated with mentalizing in relation to stimuli that signal intentions and intentional activity include regions of the temporoparietal junction.

CONCLUSIONS

The neurobiological effects of early adversity in infants and young children can be affected by changes in the caregiving environment. However, disparities in health and well-being continue at the societal level among groups exposed to high levels of adversity. Programs that use two-generation translational neuroscience frameworks, such as the FIND intervention we have described, can affect both science and policy. Specifically, they may hone interventions to be powerful yet cost effective and feasible to implement in settings with limited resources—taking the field beyond what could be accomplished with developmental science paradigms alone. Because the FIND intervention is being evaluated, we need to determine whether the conceptual model upon which it is built is empirically valid. As data from evaluation studies of FIND emerge, we also need to examine whether we can identify specific moderators of effectiveness in the individuals who take part in the intervention and in the contexts in which they exist. In doing so, the theory and practice of FIND can be adapted to increase the program's impact and reach. In presenting the FIND program and its components, we hope to guide others as they develop two-generation interventions based on translational neuroscience.

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