Civic Science for Public Use: *Mind in the Making* and Vroom

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Abstract

Mind in the Making and Vroom are partner initiatives that exemplify a unique "civic science" approach to "bringing developmental science into the world." Mind the Making offers families and professionals working with children 0-8 access to developmental research, by engaging them in an active process of professional development and community outreach. Vroom is an outreach and communication initiative that brings "brain building basics" to communities, inviting parents to participate in the science of early learning through partnerships with trusted entities. These initiatives use collaborative, iterative processes in disseminating findings and implications of child development research. Preliminary evidence shows early promise of these initiatives to help promote engaged learning and life skills based on executive function in adults and children.

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Imagine a world in which parents, caregivers and practitioners who work with children know the latest developmental science, are equipped to apply it, and even contribute to it as informed and engaged citizens. We believe this is possible, but we also believe that for this to happen, more of the sound scientific studies with clear implications for human behavior need to make their way into practice. The translation of developmental science into practice faces many challenges, starting with the need for a comprehensive understanding of the literature, leading to effective communication of this scientific evidence and its implications for practice to the public, and extending to the logistical complexities involved in bringing this evidence, on a large scale, to children, parents, and professionals who can benefit from it. This article, as part of a special issue of *Child Development*, describes two research-based efforts that focus on addressing these challenges: Mind in the Making (MITM) and Vroom.

The goal in creating Mind in the Making, originally an initiative of the Families and Work Institute and now of the Bezos Family Foundation, and Vroom, an initiative of the Bezos Family Foundation, is to foster an Early Learning Nation. This notion is based on a "civic science" framework in which educators, parents, and community members can participate directly in scientific discovery, working together with professional scientists to accelerate innovation and promote healthy development (e.g., Boyte, 2015). In keeping with our purpose in bridging the divide between the way scientific evidence is communicated within academia and public understanding, this article is written in language that is scientifically based, but intended to be accessible to the general public.

Mind in the Making and Vroom

Mind in the Making offers families of children from birth through 8 years of age, and the professionals who work with them, a learning journey into the latest scientific discoveries in developmental science. It has its origins in a book, *Mind in the Making: The Seven Essential Skills Every Child Needs* (Galinsky, 2010), that shares hundreds of studies on how young children learn academic content, including literacy (e.g., Fernald & Hurtado, 2006; Hirsh-Pasek & Golinkoff, 2003; Kuhl, 2001); math (e.g., Klibanoff, Levine, Huttenlocher, Vasilyeva, & Hedges, 2006; Ramani & Siegler, 2008); and science (e.g., Gopnik & Sobel, 2000; Newman & Keil, 2008; Strand-Cary & Klahr, 2008). In contrast to many efforts to translate developmental science, where just a few findings are implemented in a piecemeal fashion, Mind in the Making is based on a comprehensive review of the developmental literature across academic disciplines.

Recent research detailed in this book reveals that learning content is not enough, however; children also need to learn executive function (EF) skills to thrive. EF skills are top-down attentional skills that serve to shift attention flexibly in a goal-directed way, sustain attentional focus over time, and resist interference from distractions. These skills are typically measured behaviorally as cognitive flexibility, working memory, and inhibitory control (Carlson, Zelazo, & Faja, 2013; Miyake et al., 2000; Zelazo, 2015). EF skills make it possible to consider alternative perspectives and think flexibly in response to changing circumstances (cognitive flexibility), to keep information in mind so it can be used (working memory), and to resist automatic and impulsive behaviors (inhibitory control) so that one can engage in goal-directed reasoning and problem solving (e.g., Carlson et al., 2013; Gathercole, Pickering, Knight, & Stegmann, 2004; McClelland, Pointz, Messersmith, & Tominey, 2010; Rueda, Rothbart, McCandliss, Saccomanno, & Posner, 2005).

These skills, which provide a foundation for learning and adaptation across a wide range

of situations, improve considerably during childhood, and EF measured in childhood predicts a wide range of important outcomes. Children with better EF skills learn more from educational experiences and practice (e.g., Hassinger-Das, Jordan, Glutting, Irwin, & Dyson, 2014), are more likely to graduate from college (McClelland, Acock, Piccinin, Rhea, & Stallings, 2013), and to have better health and wealth in adulthood, regardless of their intelligence or social class at birth (Moffitt et al., 2011).

Developmental changes in EF co-occur with substantial structural and functional changes in neural systems involving prefrontal cortex, and these neural systems are highly plastic, or modifiable, especially during childhood. The repeated engagement and use of EF skills in problem solving strengthens these skills, increases the efficiency of the corresponding neural circuitry, and increases the likelihood that the skills will be activated in the future (Zelazo, 2015). A growing body of evidence indicates that EF skills can indeed be fostered in the context of supportive environments that provide children with opportunities to reflect upon and practice these skills. This research has not only shown training-induced behavioral improvements in EF but also identified corresponding training-induced changes in neural function (e.g., Espinet, Anderson, & Zelazo, 2013). The consequences of this research are potentially far reaching, and studies using randomized controlled designs demonstrate that improving EF skills can lead to academic success (e.g., Blakely & Carroll, 2015; Blair & Raver, 2014; Pears et al., 2013; Schmitt, McClelland, Tominey & Acock, 2015).

Mind in the Making identifies seven real-world, life skills that depend heavily on EF: *focus and self control* (see Marcovitch, Jacques, Boseovski & Zelazo, 2008; Reuda et al., 2005); *perspective taking* (see Carlson & Moses, 2001; Gopnik & Slaughter, 1991; Gopnik, 2009; Jones, Brown & Aber, 2008); *communicating* (see Hirsh-Pasek & Golinkoff, 2003); *making*

connections (see Ganea, Pickard & DeLoache, 2008; Jacques & Zelazo, 2001); *critical thinking* (see Gopnik & Sobel, 2000; Newman & Keil, 2008); *taking on challenges* (see Dweck, 2006; Gunnar, Brodersen, Krueger, & Rigatuso, 1996; Kagan, 1997; Sorce, Emde, Campos, & Klinnert, 1985), and *self-directed, engaged learning* (see Bauer, Larkina, & Deocampo, 2010; Rittle-Johnson, Saylor & Swygert, 2008; Tronick, 2007).

The strategy guiding the creation of Mind in the Making—filming researchers across many developmental disciplines while they conduct their actual studies and discuss their findings—exemplifies the notion of "civic science." It came from a series of focus groups conducted with low-income parents who wanted to understand child development research by "seeing" it for themselves, not by being "told" by experts. Mind in the Making has created an extensive video library that includes virtual field trips into the labs of more than 100 developmental researchers, showing their research in action. From these experiences, Mind in the Making has created multimedia materials designed to help diverse audiences bridge the gap between knowledge and practice, while promoting engaged learning and EF-based skills in adults and children. Mind in the Making materials include a DVD collection of 42 videos of experiments in child development research created for use in colleges and university classes; Prescriptions for Learning—free downloadable tip sheets for families and professionals on how to turn everyday behavioral challenges into opportunities for promoting the seven life skills; and a partnership with First Book (a nonprofit organization that distributes books to organizations serving low-income children at significantly reduced prices) in which a library of almost 100 children's books were selected and are accompanied by free downloadable book tips intended to promote engaged learning and the seven skills.

At the core of Mind in the Making's outreach are the Mind in the Making Seven Essential

Skills Learning Modules for Community Leaders (in English and Spanish), completed in 2013 and then revised, based on feedback from participants. With funding from the W. K. Kellogg Foundation, this series of eight in-person Modules were originally implemented in six communities with a focus on those most at risk in partnership with the Institute for Educational Leadership through community schools. Community schools, a model used in thousands of U.S. public schools, were selected as outreach partners because they bring together diverse social service and educational partners to offer a range of supports and opportunities to address the pressing needs of low-income children and families (for more about community schools, see http://www.communityschools.org/aboutschools/what_is_a_community_school.aspx).

As a way to bring Mind in the Making to scale, the eight Modules are now being implemented in an increasing number of communities, states, and systems through local funding, and as part of an ongoing, iterative process of feedback from participants and program revision. Additionally, with funding from the Popplestone Foundation, the Modules have been adapted for pediatricians and health care providers in partnership with Mount Sinai Medical Center in New York City for health systems nationwide, and for museums and libraries in partnerships with the Boston Children's Museum with museum and library educators in 30 states trained to date. A future adaptation of these materials will be for home visitors.

Vroom, an outreach and communication initiative of the Bezos Family Foundation publicly launched in 2014, brings "brain building basics" for supporting EF-based skills to communities by sharing the science of early learning and creating opportunities for dialogue and collaboration between scientists and stakeholders. Like Mind in the Making, Vroom is based on a comprehensive review of the developmental literature across academic disciplines and is guided by a Science Advisory Board from a variety of fields within developmental science and

practice (see http://www.joinvroom.org/people-and-partners). Vroom has created more than 1,000 tips for families and caregivers. These tips take everyday moments when families are already with their young children, like meal time, dressing, shopping, bed time, on the go, waiting in a doctor's office, etc., and turn them into learning moments for both children and their parents. Written in approximately 250-300 characters at a 3rd to 5th grade reading level in both English and Spanish, each tip includes a "brainy background" that explains the science behind the tip. One example of a tip for children 3 to 5 years old is Silly Sounds: "When you play Silly Sounds, you ask your child to make the opposite sound for a pair of animals. For example, if you say cat, your child should bark and if you say dog, your child should say meow. You take a turn. You can keep the game going by picking other pairs of animals." The Brainy Background explains that this activity helps children pay careful attention, use their working memories to keep the rule in mind (switch what the animals say), resist the temptation to go on auto-pilot, and instead use self-control to follow the directions. As a way to bring Vroom to scale, the tips are distributed free on the web, through local businesses and community organizations, through a free app (Daily Vroom) for smartphones, and via brands, like Goya and Johnson & Johnson. In addition, Vroom has created partnerships with national children's organizations (e.g., the National Head Start Association, Child Care Aware, Save the Children, and others), as well as Univision, to share content and spark positive parent-child interaction. Vroom has also launched community partnerships (initially with Seattle, Dallas, and the states of Oregon and Colorado) to create community engagement strategies and to share Vroom materials. Mind in the Making and Vroom have been partnering for four years and merged in 2016.

Goal of Mind in the Making and Vroom

The overarching goal of Mind in the Making and Vroom is to use the knowledge from

developmental research to promote engaged learning and EF-infused skills in adults and children by working with local communities, local and national organizations and brands, and using direct feedback regarding what works best for whom, when, and where. These initiatives are examples of a civic science approach that aims to break down barriers among science, policy and practice, enabling scientists across academic disciplines, professionals, and families to prototype ideas, to bring them to scale in language that is understandable to the general public, and to empower communities to transform themselves to promote healthy development.

Theory of Change

Mind in the Making and Vroom use a relationship-based theory of change that infuses lessons from developmental research to promote engaged learning and EF-based skills in adults and children. Rather than relying on PSAs or just creating "tips" as other current campaigns do that are primarily focused on providing information, these comprehensive initiatives draw on the growing body of research on intervention and prevention science and include professional development for adults and interventions for children aimed at embodying best practices in the field that have the greatest potential to promote EF skills (e.g., Diamond & Lee, 2011; Diamond & Ling, 2015; Shonkoff & Fisher, 2013). This theory of change includes nine tenets:

1. These initiatives begin with adults. Although it is customary for early childhood interventions to be centered on children, Mind in the Making and Vroom take a two-generational approach by first addressing adults' attitudes, knowledge and behavior (Ascend, 2011; Shonkoff & Fisher, 2013). Because children learn EF skills through their relationships with adults (Bernier, Carlson & Whipple, 2010; Bernier, Carlson, Deschêne, Matte-Gagnê, 2012; Bernier, Beauchamp, Carlson, & Lalonde, 2015; Bindman, Pomerantz, & Roisman, 2015; Meuwissen & Carlson, 2015; Ursache et al., 2014), the MITM Modules' approach is to foster life skills that

promote EF-based skills first in adults, and then help them learn how to promote these same skills in children (Center on the Developing Child, 2011).

Similarly, Vroom supports adults to be their children's "change agents." Because adults are pressed for time (Galinsky, Sakai, & Wigton, 2011) and money (Mullainathan & Shafir, 2013), the Vroom tips do not ask families to spend additional time or money but instead to engage children in everyday, everyplace learning.

2. Mind in the Making and Vroom provide adults with experiences that model and inspire engaged learning and the use of life skills that depend on EF, which, when practiced, promote the development of EF. In the MITM Modules, the trainers (or Learning Facilitators, as they are called) act as models for participants, demonstrating characteristics of interactions found to promote EF-based skills. These include acting in a sensitive and responsive way with the participants (see Ursache et al., 2014) and providing just hard-enough challenges through back and forth or "serve and return" interactions that scaffold and promote engaged learning without taking over or controlling (see Bernier et al., 2010, 2012, 2015; Bindman et al., 2015; Meuwissen & Carlson, 2015; National Scientific Council on the Developing Child, 2007; Ursache et al., 2013). The Learning Facilitators also act as role models for reflection, ensuring there is time for discussions that enable the participants to reflect on what they have learned (see Donovan, Güss, & Naslund, 2015; Zelazo, 2015). These characteristics are explicitly described in the Mind in the Making "Principles of Facilitated Learning," a copy of which participants receive during the Modules. In addition, Learning Facilitators are rated on these characteristics by participants during and at the end of the eight Modules—an example of the way participants are invited to contribute to the refinement of the Modules and how they are delivered.

3. Adults are provided with experiences and observations of actual developmental

research. Typically, parenting and teaching information is presented to adults through lectures and reading. Before a video of an actual study is shared in the MITM Modules, however, adults are given a first-hand experience with its concepts. An example is the Still-Face experiment by Tronick (2007). In the Tronick experiment, a baby is placed in an infant seat across from his or her caregiver so that they are face-to-face. The experimenter instructs the caregiver to play with the baby. Then the experimenter instructs the caregiver to turn away before returning to the face-to-face position, without reacting in any way—to keep a still (or frozen) face. In the Modules, the adult participants play a similar game. They are placed in pairs—one is given written instructions to be a "speaker"—to talk about an experience that made him or her happy, sad or angry. The other person in the pair is given written instructions to be a "listener"—to assume a "still-face," maintaining eye contact, but without showing any facial expression or using any gestures or words. Within minutes, the session erupts in emotion. The Learning Facilitator asks the participants to reflect on how it felt to be the speaker and the listener. Then the participants view the video of the actual Tronick experiment. In the ensuing discussion, participants reflect on the significance of this research in their own lives, including the power of relationships.

4. Mind in the Making and Vroom inspire rather than preach or criticize. Some of the more effective parenting interventions build on assets rather than focus on deficits. An example is the Attachment and Biobehavioral Catch-up (ABC) intervention developed by Dozier, Lindheim, and Ackerman (2005), which is focused on infants and toddlers who have been maltreated or who have experienced disruptions in care. This intervention helps parents increase their sensitivity and improve their child's attachment security and self-regulation. In parenting sessions, coaches provide "in the moment'' feedback when parents are engaging in behaviors that promote these goals (versus criticizing what the parents are doing "wrong"),

leading to an increase in positive behaviors (Dozier et al., 2005).

Mind in the Making takes this kind of approach through positive feedback in the Modules, as well. In between each session, participants try out what they have learned and report back. The Learning Facilitators point out behaviors that promote engaged learning and EF-based skills.

Parents may worry that they do not have the tools or resources necessary to help their children learn and develop to their full potential. Instead of focusing on perceived deficits, the video introducing Vroom to families encourages parents to consider a different perspective. The video takes viewers into the homes of parents who are busy, rushed, and concerned that they are not doing enough for their young children. Then, they receive a surprising package that contains a mirror. The parents in the video look at themselves in the mirror and read the words on the mirror that say, "You already have what it takes" (see http://www.joinvroom.org). This image sends a powerful message to participants that they, too, have what it takes to help their children.

5. Mind in the Making and Vroom include child interventions, in addition to their adult interventions. A number of interventions that began as parent interventions have expanded to encompass children and teachers (see Brotman's ParentCorps as an example: Brotman et al., 2013). Because both Mind in the Making and Vroom are adult interventions, they are paired with evidence-based child interventions to further ensure a two-generation approach. Thus, in a number of sites, MITM Modules and Vroom are accompanied by Circle Time Games—games that promote EF skills in children by increasing in cognitive complexity and providing children with appropriately challenging opportunities to practice these skills (Tominey & McClelland, 2011). Two randomized controlled trials have evaluated this intervention (Tominey & McClelland, 2011; Schmitt et al., 2015) and found significant improvements in EF

with transfer to improved academic skills. In one recent evaluation of the Circle Time Games with a Head Start sample (N = 280), children in the intervention group demonstrated higher levels of EF skills compared with a business-as-usual control group in the spring of the preschool year and significantly higher math skills for children who were English language learners (Schmitt et al., 2015). Another study found that children receiving Circle Time Games in addition to a school readiness summer program significantly improved their EF skills compared with an active control group (e.g., children who received the summer program but without the Circle Time Games (Schmitt, McClelland & Duncan, 2016). In the future, Mind in the Making and Vroom will be also paired with Tools of the Mind (Bodrova & Leong, 2007), a child intervention that promotes EF in the preschool-kindergarten years (see Blair & Raver, 2014 for a recent evaluation of the effectiveness of this approach).

6. Goal setting is fostered among adults, helping them to direct and drive their own developmental changes. Because EF skills are goal directed (Carlson et al., 2013), the MITM Modules help participants set personal and professional goals for promoting life skills that promote EF in themselves and in children. Creating this approach to goal setting is an example of the iterative process of discovery, improvement and civic science that has guided this work throughout. When the Modules were first created, they included an activity book but this process was not deemed robust enough to drive change. Thus the Mind in the Making team partnered with Gabriele Oettingen to create an evidence-based goal setting process in each Module. Oettingen (2012; Oettingen, Pak, & Schnetter, 2001) has found that "mental contrasting" (naming a wish, imagining its positive outcome, then imagining those obstacles of present reality that stand in the way of wish fulfillment) leads to strong goal pursuit. Along with forming "implementation intentions" or if-then plans (Gollwitzer, 1999, 2014) used to effectively deal

with the obstacles (Gollwitzer, 1999, 2014), mental contrasting makes the achievement of goals even more likely (Oettingen, 2014; Oettingen & Gollwitzer, 2015).

7. Multiple Mind in the Making and Vroom tips take place throughout the day so that developmental knowledge is evident in all contexts. Families who sign up for the Daily Vroom app on their smartphones receive a daily notification of a Vroom tip, customized for the ages of their children, including children's first names. The app also includes other tips that span the day, from waking up in the morning through bedtime and all of the places that parents and children go in between—at home, in cars and public transportation, in markets, waiting for appointments, etc. When Vroom launches in communities, tips are distributed to the multiple agencies that work with families of young children. In addition, there are billboards and community art; for example, teens created "ads" for their younger siblings on bus stops in Seattle. The app provides frequent opportunities for practicing these skills in multiple different contexts, which is vital for generalized improvement of EF skills (Diamond & Lee, 2011).

8. **Mind in the Making and Vroom have created partnerships within communities and national organizations to use and disseminate tools and materials.** Mind in the Making and Vroom are taking a multi-level approach to dissemination. Together and apart, they are working deeply in communities and states (3 for Vroom; 18 for Mind in the Making and Vroom to date). The MITM Modules were originally created to bring together community leaders who work with children from birth through 8, such as educators in schools and early childhood programs—including parents and teachers together—and social service providers. The Modules have been adapted for the sectors that are the most likely to affect the lives of young children: health care professionals, museum and library professionals, and home visitors.

9. The impact of Mind in the Making and Vroom are being evaluated through research,

which will be used to inform future changes. The MITM Modules, Vroom and the Circle Time Games are currently being evaluated in a school-based rapid cycle trial in Evansville, Indiana. In this intervention, teachers are receiving training in the MITM Modules, children are participating in the Circle Time Games designed to provide practice with EF skills (Tominey & McClelland, 2011), and parents are receiving tips via Daily Vroom as well as printed tips sent home in children's backpacks on how to promote the healthy development of EF skills. The evaluation addresses five questions: (1) Has the knowledge outlined in the Modules' learning goals increased in participants? (2) Has adult EF improved? (3) Have the interventions improved EF and academic achievement in children? (4) Has MITM training improved classroom quality? (5) Have the interventions improved parent-child interactions? Although the actual training is typically eight weeks, the impact is expected to be more durable because parents and teachers have been trained to become agents of change and can transform the moments they share with children. In addition, teachers are expected to continue the Circle Time Games, parents will continue to receive tips through the Vroom app, and the life skill information has become infused into other community organizations (libraries provide the MITM book tips, the children's museum has been reorganized around the life skills, etc.).

A small feasibility study recently conducted with this population of children in Indiana (N = 33) showed promising results with researchers finding that after six weeks of the MITM Modules, Vroom and the Circle Time Games, gains on two tests of EF skills (Minnesota Executive Function Scale and Head-Toes-Knees-Shoulders) and the Woodcock-Johnson Applied Problems subtest were on par with what is typically seen in six months of development (Carlson & Zelazo, 2015; McGrew & Woodcock, 2001). A larger randomized controlled trial is currently underway (Zelazo, Carlson, McClelland, Distefano, Miao & Diaz, 2016). A total of 12 preschool

teachers are learning the MITM Modules, receiving daily Vroom tips, and being trained to administer the Circle Time Games. Eighty parents and almost 200 children ages 3-5 are being pre-tested on measures of EF, theory of mind, and math and reading readiness, and then post-tested on the same measures after six weeks of the intervention and a month after the intervention is completed. It is expected that EF gains conferred by the Mind in the Making /Vroom "lens" and the Circle Time Games will be significantly related to learning readiness in mathematics and reading.

Uptake as Evidence of Success

There has been tremendous uptake of both initiatives, suggesting that the public is hungry for such information presented through a civic science approach. With Vroom, just over a year into launch, more than 100,000 families have been reached through the app and community partnerships, and the Daily Vroom app has been downloaded in more than 100 countries. The use of the Mind in the Making materials is also widespread. The DVD collection of 42 videos of experiments in child development research is being used in more than 700 colleges and universities, and the free MITM book tips have been downloaded almost 500,000 times.

While the MITM Modules were originally funded by the W.K. Kellogg Foundation for implementation in six communities (Tulsa, OK; Portland, OR; New York City; Evansville, IN; Hartford, CT; and Providence, RI), they have been adopted with Vroom by 18 communities and states.

The Modules were chosen for implementation as a part of a 2015 U.S. Department of Education Race to the Top grant in Oregon and a 2014 U.S. Department of Education's Investing in Innovation Fund (i3), given to the Providence, RI Public School Department (PPSD) and Ready to Learn Providence. The goal of this 4-year grant is to bring Mind in the Making to the

families of children in Pre-Kindergarten through Grade 3 and faculty and staff in all 22 elementary schools in Providence. To date, they have trained 982 families and 359 professionals. An external evaluation is being conducted by the Wellesley Centers for Women. In their second year, they have found significant increases in families' belief in their efficacy in influencing their child's schooling, decreases in authoritarian parenting, and according to educators, increases in family engagement. The evaluation is also examining changes in children's academic outcomes and EF.

Summary and Future Directions

Mind in the Making and Vroom are unique among current dissemination efforts because they address real world problems, are anchored in developmental science, use novel delivery methods (video, smartphone, community engagement, and in-person teacher and parent training), bring together unusual partners (states, schools and early childhood programs, health care and museum and library professionals, scientists, and commerical partners such as Goya and Johnson & Johnson), and are being rigorously evaluated. They are designed to address some of the substantial challenges facing the effective translation of developmental science into practice, helping. As an example of civic science, Mind in the Making and Vroom bring developmental science and its implication directly into the lives of families who can benefit from its implications, including those families who need it most. Our hope is that they can be used to bring together people across the country who are working to help young children, their families, and the professionals who work with them, thrive.

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Conflict of Interest

Ellen Galinsky is the author of *Mind in the Making: Seven Essential Skills Every Child Needs* (HarperCollings, 2010). The book is given to participants in the training free of charge by the Bezos Family Foundation.

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