Appendix B:
Examining Children's School Readiness Outcomes:
Effects of Enhancements to Early Childhood Programs

Appendix B.1:
What It Means and What It Takes to Prepare Children for School: A Synthesis of Evidence for the Impacts of Federally-Funded Research Initiatives in Early Childhood Education

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In the last ten years, there has been a rapid increase in the number of research studies examining the impacts of preschool interventions on children's school readiness outcomes, with many of these studies using rigorous experimental methods that allow attribution of causal relationships. A substantial proportion of these studies have been supported through federal funding, as stand-alone evaluations of federal programs such as the Head Start Impact Study, as part of research initiatives such as the Preschool Curriculum Evaluation Research Initiative, or as individual studies funded through grants. State and local governments, as well as private funders, have also supported recent research studies of preschool interventions. One of the hallmarks of the current crop of research studies is the focus on the right hand side of the equation; that is, the studies are not simply concerned with demonstrating the size of the impacts on child outcomes but also with trying to understand the processes responsible for the impacts that are obtained.

The most recent meta-analyses of early childhood education programs (Jacob, Creps & Boulay, 2004; Nelson & Westhues, 2003; Gorey, 2001; Gilliam & Zigler, 2000) focus on the average size of the impacts of a range of early childhood education interventions. The meta-analyses either bypass the question of variation in instructional inputs as they relate to effect size or focus on programmatic features such as length of day, comprehensiveness of services or auspice rather than instructional methods. However, the research agenda in the past five to ten years has moved beyond proving that early childhood education can make a difference to children, especially at-risk children, to trying to build a body of knowledge about how to successfully intervene with at-risk children to improve their school readiness. The three summary papers discussed here are directly concerned with the most current evidence for instructional practices, interventions, curricula, and programs that have been shown to impact children's development in three domains: language and literacy, math, or socioemotional development.

The question being posed concerns the contributions of this emerging body of research as a source of new evidence or as an extension of what we know about effective interventions for school readiness. On the one hand, the three summary papers suggest that there are an increasing variety of types of early childhood education interventions and curricula that are effective at improving children's school readiness-related outcomes across domains. On the other hand, there are important limitations of the research. First, almost all of the interventions being tested encompass multiple components and the designs do not allow us to "unbundle" these components analytically to determine which programmatic factors make the biggest difference for children's outcomes. When the research is examined for lessons about variation in instruction, the interventions being compared differ on so many factors that it is impossible unable to link outcomes to specific characteristics of instruction or environmental changes. Just as in the past, this current research primarily consists of stand-alone studies, essentially unconnected to one another in any logical way nor connected to a systematic, integrated research plan. At the present time, the research does not go much further in helping us isolate the "potent" or "active" ingredients in instruction that are critical to different child outcomes.

The second limitation is that studies are not connected by a consistent definition of what in fact constitutes school readiness. Studies tend to use measures that align with the intervention and do not attempt to assess a more comprehensive set of outcomes across other domains. This limits our ability to compare the effects of different intervention strategies and to answer questions about whether focusing on one aspect of school readiness (e.g., self-regulation) has generalized impacts across other outcome domains.

Building a systematic knowledge base on effective practices, or a 'science of practice' for promoting school readiness will require an "infrastructure" to guide and link the research. More specifically, the infrastructure will be built on answers to two over-arching questions:

1. What constitutes school readiness?

    a. Do we understand the foundational skills/content knowledge/understandings that children need to develop by the time they enter school for academic success in both early elementary grades and longer?

    b. What is the developmental trajectory of these foundational skills?

A common definition of what is meant by "school readiness" will contribute to the ability to standardize the research on school readiness. A justifiable definition of school readiness will depend on evidence showing that skills developed during the preschool period have impacts on later school performance. While each of the three papers offers some rationale for linking the preschool outcomes in their domain to academic outcomes, the rationales are based on a mix of theory, opinions and correlational research. Even in the field of language and literacy, where the soon-to-be-released report from the National Early Literacy Panel will present a comprehensive summary of the research literature about the early or foundational skills/knowledge that are the strongest predictors of later reading achievement, the research base is correlational. Although some of the research reported in these papers will be able to test causal relationships between preschool and school outcomes, assuming long-term follow-up of children, for most of the interventions, it is too early to show long-term effects for children's academic performance and even longer-term social outcomes such as higher education and/or economic productivity. As such evidence is reported, it will be a basis for beginning to build a stronger research-based definition of school readiness. It is worth noting that there are other forces pushing us toward a measurable definition of school readiness. The large scale investments in early childhood through universal pre-kindergarten initiatives and quality improvement systems are being justified in terms of improvements in school readiness. In theory, a definition of school readiness should rest on research linking preschool skills/content knowledge/understandings to later school achievement.

Further, we need longitudinal evidence of the developmental trajectory of skills purported to be foundational.

2. What do we know about the contribution or influence of environmental factors in the development of the foundational skills, and can we build effective interventions based on this knowledge?

    a. Is there evidence that the skills are learnable or modifiable and therefore susceptible to intervention?

    b. Based on theory or basic research, can we develop effective interventions to enhance the development of these skills?

    c. Can we show a causal link between specific instructional practices and student school readiness-related outcomes?

Interventions aimed at enhancing children's school readiness are based on two premises: (a) that the skills being taught or supported by the intervention are learnable, and (b) that there is research or theory to justify the intervention strategies for changing the early childhood education experience so as to alter the developmental trajectory. Even when there is clear agreement on objectives for children at the end of preschool, there are typically alternative theories about effective intervention approaches, as reflected in the variability across intervention designs. This brings us back to the question of which intervention strategies are most powerful in creating changes in children.

The current research is insufficient for understanding the process by which these interventions lead to child impacts. We don't know which of the changes being created in early childhood environments through multi-faceted interventions are the causal factors in changing student outcomes. Even the experimental studies being conducted can't, in fact, establish that the teachers or classrooms that changed the most as a result of the intervention are the same sites where the child outcomes changed the most.

One approach that has been used to begin to build this information base is planned variation research, where the research is designed to systematically test different intervention strategies with similar children and a common set of outcomes, to attempt to isolate which models have the largest impacts. However, unless this type of planned variation research varies and compares the impacts of intervention components rather than multi-dimensional models, it is not possible for the research to provide us with the information we want about mechanisms of change.[1] Further, this kind of planned variation research focuses on the relative contribution of components of the instructional intervention. There are other aspects of the environment that are additional potential factors in the impact of instruction, such as how the classroom is managed (e.g., discipline, grouping), class size and heterogeneity of the child in terms of characteristics such as home language, special needs and the like. Research that allows us to disentangle the combined and individual effects of all of these factors will require complex designs and sample sizes that permit us to test multiple variations.

What follows is an overview of the conclusions from the three synthesis papers about where the current research stands in terms of the content and focus of the interventions being tested, what the findings tell us about effective instructional strategies, and what types of future research will be most informative. The two issues raised above—defining school readiness and the developmental

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[1] The traditional method used to link interventions to outcomes, even in the context of randomized designs, is based on OLS regression, in which variation in implementation is correlated with variation in outcomes. Another experimental approach uses instrumental variable analysis. This approach has been applied in many contexts by economists and is becoming increasingly popular for use with randomized experiments (for example, Angrist, Imbens and Rubin, 1996). It does not compare existing levels of student achievement and instructional practice. Instead it leverages the fact that a high-quality randomized experiment (or a well-executed regression discontinuity analysis) can produce unbiased estimates of program impacts on classroom instructional practices and on student test scores. The approach thus examines the association between outcomes that is implied by a pattern of program impacts. For example, in a randomized study, the analysis compares program-induced changes in student outcomes with program-induced changes in classroom instruction, where both changes are estimated using the randomized design. Under certain conditions, this analysis can provide internally valid (statistically consistent) estimates of the causal effect of classroom instruction on student performance. This methodology overcomes some of the problems in relational analysis (omitted variables and attenuation bias), although instrumental variable analysis depends on being able to show that there are no mediators additional to the classroom instruction that could account for the relationships with child outcomes.

trajectory of foundational skills and identifying the active ingredients in interventions—will resonate through the overview.

The outcomes of these interventions are discussed in the context of the following domains: socioemotional, language and literacy, and then math. The paper starts with the socioemotional domain because the constituent skills are hypothesized as constituting the platform underlying the child's ability to negotiate successfully all other learning tasks, including early literacy and early math understandings. The second domain discussed is language and literacy. Although language and literacy are often paired, in many respects language should be considered in conjunction with socioemotional development, because of the broad central role language plays in children's learning. For the developing child, the ability to understand and use language is the primary mode by which he builds knowledge of the world and communicates his own ideas and feelings. In this sense, most aspects of socioemotional development are completely intertwined with language development: Children's internalized regulatory mechanisms are language-based, their social understanding is language-based, and their ability to interact and engage with others is primarily negotiated through language. Language development can be labeled as an "engine" of development.

Early literacy and early math are the final outcome areas discussed. As opposed to socioemotional and oral language outcomes, early literacy and math both represent specific skills and understandings. Literacy, for example, includes print knowledge, the alphabetic code and phonological processing (phonological memory, access, and awareness); math includes number and operations with numbers, geometric shapes, spatial relations, and measurement.

Socioemotional Domain

As Raver reports, the current conceptualization of the socioemotional domain distinguishes three major mechanisms or processes that support children's development: self- regulation (emotional and cognitive), social cognitions, and prosocial skills. Raver also describes a fourth area of socioemotional development, behavior problems (externalizing and internalizing), which factors into children's ability to learn and relate to other people. The behavioral manifestations of these processes, taken together, form a picture of a child socially and emotionally ready for school. This child is able to:

- follow adult directions;
- control his/her own emotions, attention, and impulses independent of adult regulation;
- establish positive social relationships with peers and adults;
- successfully solve social problems without being disruptive or aggressive;
- attend in a sustained way to learning tasks in the environment;
- evaluate his/her own behavior and make corrections; and
- demonstrate "cognitive flexibility."

Raver's description of the intervention research in the socioemotional domain clusters studies based on which of the three underlying processes the interventions are designed to effect. The research on interventions in the socioemotional domain is most consistent in the area of self-regulation and social skills. Evidence of the ability to reduce aggressive behavior in the classroom is more mixed. Further, all of the data reported represents short-term findings, with no evidence to date of longer-term benefits for school performance. Further gaps include: evidence of whether and how the various components of socioemotional functioning are inter-connected; and evidence of the

relationship of children's development of self-regulatory and social relationship skills in preschool to their oral language development or to the acquisition of early literacy or math skills. As discussed above, the fact that disparate intervention strategies all appear to have impacts raises the question of the mechanisms leading to child impacts.

Impacts on Children's Self-Regulation Skills

In the area of self-regulation, Raver cites evidence that children's attentional processes can be enhanced through a variety of intervention mechanisms. For example, Raver cites three interventions as having impacts on children's self-regulatory skills:

- **Project REDI:** uses small-group lessons focused on understanding emotions to help children regulate behavior and successfully negotiate social relationship; trains teachers on classroom management strategies that create a positive learning climate; uses instructional strategies in early literacy to build oral language skills and phonemic awareness that promote teacher/child interaction (scripted dialogic reading exercises to promote conversation and build vocabulary and small-group phonemic awareness activities to teach sounds and words).
- **Chicago School Readiness Project (CSRP):** focuses on improving the emotional climate of the class by providing teachers with training in behavior management and in-class coaching by mental health consultants on implementing positive behavior management strategies.
- **Tools of the Mind:** uses role play as a central mechanism to help children develop "self-regulatory scripts" to guide their own behavior; thematic dramatic play is the central type of role play, but roles also are used in children's work with peers in reading and other content areas.

All three of these interventions have reported impacts on children's levels of attention and focused effort and persistence, as measured through direct observations,[2] despite the fact that the three interventions use very different approaches. REDI and CSRP use the teacher as the primary change agent for helping children develop self-regulation, while Tools uses children's own role play to help children develop their own self-regulatory scripts. The fact that all three interventions report impacts on children's development of self-regulation skills and all three use multiple avenues to affect these changes underlines the importance of systematic research to isolate the most important "levers." Further, data on the long-term effects of these curricula will be crucial for understanding whether the differences in the approaches of Tools versus REDI and CSRP have ramifications for the persistence of impacts over time, once children leave supportive early childhood environments. If the children in Tools of the Mind build internal self-regulatory structures while children in REDI or CSRP are more dependent on the actions of the teacher, then it is possible that Tools will have more robust long-term impacts.

[2] The fact that parallel effects were not demonstrated on teacher ratings of children's attention and impulsivity may be related to power rather than to inconsistency in outcomes. Teacher ratings have been found to have higher correlations among children in the same classroom and center (ICCs) than do cognitive measures such as the PPVT. This means that only relatively large impacts can be detected for the teacher-reported outcomes,

Long-term follow-up data on differences in school performance for children with stronger or weaker self-regulation at the end of preschool will also provide important information to prove or disprove the contention that self-regulation encompasses a skill set that influences learning across content areas and across ages. For the same reason, it is important that the research on these interventions includes measures of children's acquisition of skills in other curriculum areas, such as early literacy or early math at the end of preschool. (For example, in the research on *Tools*, children not only develop stronger attentional processes, they also score higher on standardized tests of math at the end of preschool.)

In general, the maintenance of gains in preschool may depend not only on the types of behavioral and/or attentional changes that children experience in preschool but also on the characteristics of their subsequent classroom environments in elementary school. Gains in preschool may be maintained or even enhanced if children experience classroom environments in elementary school that continue to support positive, regulated behavior.

Impacts on Children's Social Cognitions and Prosocial Skills

A second area of intervention research described by Raver focuses on the social cognitive mechanisms underlying children's ability to form and sustain positive interpersonal relationships with peers and adults in the classroom and to solve problems in social relationships. The social cognitive mechanisms include: children's knowledge of emotions—their own and other people's; knowledge of prosocial behaviors (e.g. helping, sharing, and taking turns); and the ability to generate and use more effective social problem-solving skills. In this area, the child who is ready for school:

- Can develop a positive, engaged social relationship with the teacher;
- Can form positive friendships with peers;
- Can successfully solve problems that arise in social interactions with peers;
- Demonstrates prosocial behavior in the classroom, such as helping other children, sharing, and taking turns;
- Does not act aggressively with other children or adults.
- Does not act disruptively in the classroom.

In the same way that self-regulatory skills are correlated with children's learning across domains, children's social skills and the quality of their relationship with teachers have been found to be correlated to their later social and academic competence in early elementary school.

Raver focuses on the results from three interventions:

- **Project REDI** trains teachers to provide more emotional coaching and support in the classroom and includes a socioemotional curriculum that helps children develop emotional knowledge and accurate social attributions, and prosocial behavior strategies for interactions with peers. REDI reports significant differences for children's emotion understanding and interpersonal problem-solving, and significant gains in children's social competence (teacher rated aggression and observer-rated social competence). The project also reports significant changes in teachers' use of emotion coaching, positive classroom management and behavioral support.

- **My Teaching Partner,** a web-based teacher training curriculum developed by Pianta, focused on improving teacher/student relationships to be more responsive and supportive. Results showed that intervention teachers demonstrated significantly more sensitivity, language modeling, and quality of instructional support to students.
- CSRP also worked with teachers to establish more positive classroom environments, and there was a significant impact of the on positive classroom climate (d = .52 to d = .89). Although there was no child-focused curriculum on emotional language or self-awareness, the gains in children's behavioral self-regulation were attributed to the enhanced classroom environment.

Impacts on Children's Behavior Problems

Fewer studies have measured impacts of interventions on children's behavior problems. *Project REDI*, a socioemotional learning curriculum, reported significant reductions of children's aggression, as reported by teachers. Similarly, CSRP reports reductions in children's externalizing and internalizing problems as reported by teachers. Across the PCER studies, there were no effects on children's behavior problems as reported by teachers.

Language and Literacy

In many respects, the conceptualization of the critical foundational skills to be acquired during preschool has moved furthest along in the area of language and literacy. There has been a wealth of theoretical writings, professional opinions, and best practice documents proposing which skills are the precursors or foundational skills for reading achievement, and, it is only in the field of language and early literacy that we [soon] will have a systematic empirical summation of research demonstrating which early literacy skills predict later conventional literacy (via the National Early Literacy Panel). There is beginning to be a structure for understanding the developmental precursors to later reading and writing abilities. Further, in the challenge of defining school readiness, this domain has the advantage of the widely-shared criterion of the critical long-term academic outcome—becoming a skilled reader (with strong decoding and comprehension skills, a strong vocabulary, automaticity in reading).

Before the NELP, the field was driven in its thinking about "readiness" skills by two documents that provided consensus or narrative summaries of a portion of the research literature concerning the relation between early precursor skills and later conventional literacy skills: Whitehurst and Lonigan (1998) identified skills in the domains of oral language, print and letter knowledge, and phonological processing as encompassing two aspects (outside-in and inside-out skills) of emergent literacy that are related to later conventional forms of reading and writing; and Snow, Burns, and Griffin (1998), in their report of the National Research Council's panel on preventing reading difficulties in young children, identified weaknesses in oral language, phonological awareness, and alphabet knowledge as prime targets of intervention to prevent the occurrence of significant reading problems. Neither of these documents, however, was based on a comprehensive summary of the published literature.

The NELP provides an evidence base about early or foundational skills/knowledge that are the strongest predictors of reading achievement, as well as a summary of the average effects of the number of interventions to improve early literacy/language skills. In the ensuing discussion, we start with oral language and then move to early literacy, for the reasons spelled out above.

Oral Language

Oral language skills can be conceptualized as including productive language skills (forming sounds correctly, using the right forms of words, forming correct sentence syntax), language use (using words to express thoughts or ideas or to transmit information); and language content (understanding of vocabulary and narrative). In describing a child who is ready for school in terms of his/her oral language skills, the following skills are included:

- Ability to express thoughts, ideas into spoken words;
- Ability to understand other people when they talk;
- Ability to carry on a back-and-forth conversation with another person;
- Ability to use correct versions of plural, past and future tenses.
- Ability to understand narrative sequence (logical order of events);
- Expressive vocabulary that includes knowledge of words likely to be encountered in early readers; understanding of superordinate words for categories of objects (silverware, clothes, tools, etc).

As described in the synthesis paper by Caswell and He, numerous research studies have demonstrated a relationship between early, well-developed oral language skills and later reading abilities. Despite the primary of oral language skills in a child's cognitive readiness for school and, ultimately, for learning to read, the evidence for intervention effects is somewhat disappointing. Across the large number of interventions concerned with children's oral language outcomes, most show small to medium effects.

The synthesis paper describes some of the variety in the oral language activities used to promote children's understanding of vocabulary, comprehension of concepts, and language use. The problem with the research is that in most instances, the intervention being examined includes more than one type of oral language activity, as well as other literacy-related activities, so it is impossible to isolate the impact of the any one type of oral language activity. For example, a number of programs use dialogic reading to promote children's oral language skills. This includes dialogic reading as the sole intervention activity and dialogic reading that is integrated into a broader curriculum with additional activities and goals. There were inconsistent results of these interventions on children's outcomes, although most did find at least a small effect on children's vocabulary. Again, where dialogic reading was just one activity in the curriculum, we cannot know whether it was the dialogic reading was responsible for the impacts on vocabulary that were found.

Most of the research on oral language effects comes from studies of comprehensive or multi-dimensional curricula that included some oral language activities but were not focused on language specifically. The findings for impacts on oral language skills were inconsistent across studies.

Phonological Awareness

Phonological awareness is a component of the broader skill area of phonological processing, which includes not only the child's awareness of sounds, but also the ability to hold sounds in memory and to be able to access sounds from memory. Phonological awareness refers to the child's understanding that words are made up of smaller sounds that can be manipulated, combined and separated. This

knowledge helps children understand the relationship between written language (letters) and spoken language (sounds). Research has established that phonological awareness develops in the preschool period starting with sensitivity to words and moving toward sensitivity to smaller and smaller units of sound (syllables, onset-rime, and phonemes).

Phonological awareness has been shown to be a strong predictor of reading success. At the same time, there is inconsistent evidence of our ability to impact children's phonological awareness skills. The strongest evidence comes from research on individual literacy curricula with some explicit attention to sounds in language, including two curricula studies in Project Upgrade and a couple of individual PCER studies of literacy curricula. In these evaluations, the children receiving the literacy curricula scored higher on a test of sound blending and elision. No evidence of an effect on phonological awareness was found in the Head Start Impact evaluation or the Early Reading First evaluation, possibly because local programs vary widely in the extent to which instruction incorporates an intentional and consistent focus on sounds.

Print Knowledge

Research indicates that print and letter knowledge are strongly related to later reading performance. Children's knowledge of the alphabet when they enter school is one of the single best predictors of later reading achievement, most likely because the ability to recognize and distinguish individual letters is a necessary precursor to learning the sounds that the letters represent. Overall, this component of early literacy is the one most often targeted by interventions.

The majority of the interventions reviewed targeted children's print knowledge as an essential skill and there was consistent evidence that the interventions were effective in improving children's print and letter knowledge. This included the large national early childhood studies, where there was substantial variation across sites in the programmatic activities and individual curricula.

Early Math

As argued by Ginsburg et. al, the fact that the intervention research on early math lags behind the research on early literacy can be explained at least partially by the long-held belief that young children are not able to understand mathematics in complex ways, and that even "everyday" mathematical skills cannot be cultivated in children as young as preschool. As research has built the case showing just the opposite, early math concepts are now central in early childhood education standards, and comprehensive early childhood curricula include deliberate, organized activities to promote understanding of mathematical concepts.

What are the early mathematical concepts that children should acquire in preparation for school? There does not appear to have been extensive conversation among math educators and researchers about what mathematical concepts constitute school readiness. Across the curricula that have been developed, there are similarities in the content areas, however, including:

- basic aspects of number and operations,
- geometric shapes,
- spatial relations,
- measurement, and
- patterns and logic.

The paper discusses six mathematics curricula for preschool on which impact research has been conducted in the United States and two with research from New Zealand. The paper also considers results from research on mathematics activities included as part of comprehensive curricula. As described in the paper, the curricula have different learning objectives and use a variety of materials and approaches, including games, story books, activities, manipulatives, and computer software; stand-alone activities and other activities. Across the various curricula and approaches, most had statistically significant impacts of at least moderate size. Since no two curricula studies used the same measure, it is difficult to compare effectiveness. Further, the research is not useful for determining which aspects of the instruction were most powerful in improving children's math knowledge. Long-term follow-up data also appear to be missing.

Final Thoughts/Future Research

The current set of research summarized in the three syntheses has moved the field forward in some respects. Until recently, there has been almost single-minded focus on language and literacy, which has conferred benefits in terms of the relative breadth and depth of knowledge we have for that domain. The current research reflects a new priority on socioemotional skills, especially self-regulation, and this has opened up new funding opportunities and new intervention designs, which are crucial for our ability to develop our knowledge base in this domain. Early math is also now receiving more scrutiny, although the research base is much more limited.

The current set of research studies does not address directly the critical over-arching issues of what constitutes school readiness, the developmental trajectory of the component skills in readiness, and the long-term benefits of early skill development in both the academic and social domains. The lack of a definition of readiness makes it difficult to summarize the findings from a large set of research studies, since different studies not only use different measures of the same construct but also assess a different set of constructs. Not only does this hinder comparisons, it also limits our ability to understand whether an intervention has broad or narrow effects on children's school readiness.

Nor is the research designed to yield supportable conclusions about the relationship between specific environmental inputs (intentional teaching, materials, technology) and child outcomes that go beyond simple correlations, for example, through systematic planned variation studies or through complex analyses such as instrumental variable analysis.

There also is a clear need for more longitudinal research on the development of children's early skills in all three domains, at least through preschool and into the early elementary grades.

All three synthesis papers note that future research will need to more clearly delineate the sources of variation in impact, as well as the overall impact. Potential factors include characteristics of students as well as of teachers and of the intervention itself.

The field is attempting to simultaneously develop effective, research-linked interventions, deliver them with high fidelity in a variety of education settings, use valid, reliable measures of what are often complex psychological constructs, and contribute to building a knowledge base on instructional practices. Despite the sometimes disappointing findings, we need to understand the difficulty of designing effective interventions to be implemented in real-life educational settings, with groups of at-risk children.

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