



Pre-K Content Blueprint Series

# Executive Function

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Developing Assessments for All Pre-K Children

September 2025

MEASURES FOR EARLY SUCCESS

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# Introduction

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The Pre-K Content Blueprints are intended to help assessment developers learn about and design assessment tools that provide more accurate information about young children's early learning and development. Assessment developers can use these blueprints as they embark on content research, concept definition, and product development to ensure that their decision-making is grounded in the needs that are outlined in the [User-Informed Principles](#).<sup>1</sup>

The Pre-K Content Blueprints were originally developed in 2022 to guide the work of the project teams that were selected to design novel assessments through the [Measures for Early Success Initiative](#).<sup>2</sup>

## How were the Pre-K Content Blueprints developed?

Each Pre-K Content Blueprint was developed through a systematic review of Head Start and select states' early learning standards (using what was publicly available as of early 2022), as well as theoretical and empirical literature on children's development. To benefit all children served by public pre-K programs, the Pre-K Content Blueprints consider a variety of perspectives, experiences, and needs to highlight domain-specific opportunities for assessment design to ensure that all children are given a fair chance to show what they know and can do.<sup>3</sup>

## About the Measures for Early Success Initiative

Central to the Measures for Early Success Initiative is the belief that early learning assessments are a powerful tool for understanding young children's strengths and competencies and where they are at in their learning and development.

Data from assessments can provide users with information to:

- help tailor instruction in the classroom,
- support children's learning in key areas that are unique to them,
- provide or recommend additional support for specific children, and
- inform pre-K system-level policies and supports for pre-K programs.

**A key objective of the Measures for Early Success Initiative is to create innovative assessments that provide accurate insights into what all children know and can do.**

# How can this resource be used?

The Measures for Early Success Initiative generated a set of Pre-K Content Blueprints to guide assessment development in the following domains:\*

- Language
- Literacy
- Mathematics
- Executive Function

Each Pre-K Content Blueprint has three primary goals:

**Describe skills in each domain and how they develop in children from ages 3 to 5.**

**Place assessment users' perspectives and needs at the center of the design of innovative assessments in each domain.**

**Provide an overview of existing assessments in each domain and highlight some ways that they advance toward the goals outlined in the *User-Informed Principles*.**

\*These domains were emphasized in the first phase of the Measures for Early Success Initiative (through 2024) because current direct assessment tools for these domains are most developed.

**Pre-K Content Blueprints can be used in conjunction with the following resources that were developed for the Measures for Early Success Initiative:**

- The [User-Informed Principles](#) resource highlights key goals for innovative child assessment solutions with corresponding criteria and target thresholds. It can help assessment developers address challenges in the current assessment landscape by helping them to identify areas where existing solutions do not address users' priorities; possible measurement items or solutions to address these gaps; and important areas or features to design to ensure that assessments are relevant for all pre-K children.
- [Centering User Perspectives in Assessment Design](#) describes how assessment tools can be designed in more accurate, usable, and useful ways by integrating users' perspectives, strengths, and needs early in the assessment design process.<sup>4</sup> This resource can be used to make progress toward the goals outlined in the *User-Informed Principles*.
- [Pre-K Content Blueprint Series - Technical Manual](#) describes the process for using federal and state early learning standards to summarize children's skills and developmental trajectories that are presented in the *Pre-K Content Blueprint Series*.<sup>5</sup>

# Federal and State Early Learning Standards

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Federal and state early learning standards describe the concepts and skills children develop and learn along the developmental continuum from birth until kindergarten entry. The purpose of these early learning standards is to inform the work of those aiming to foster the healthy development and well-being of young children. Early learning standards often represent minimum thresholds for children’s development at various ages. Curricular supports, resources, and activities are selected to align with early learning standards. Pre-K programs also use early learning standards to select assessment tools that track children’s developmental progression across early learning domains.

For the purposes of capturing children’s skills and developmental progression from ages 3 to 5, this Content Blueprint presents definitions and summarizes developmental progressions—generated from the Head Start Early Learning Outcomes Framework (ELOF) and a subset of the early learning standards from the Measures Initiative’s advisory states—using publicly available information as of early 2022.

## **Federal early learning standards reflected in the Pre-K Content Blueprints**

The Pre-K Content Blueprints feature early learning standards from the Head Start Early Learning Outcomes Framework (ELOF),<sup>7</sup> which guides federally funded Head Start programs across the country.

## **States’ early learning standards reflected in the Pre-K Content Blueprints**

The Measures for Early Success Initiative engaged with pre-K leaders from over 20 states to gather their thoughts and feedback on child assessments.

To create the Pre-K Content Blueprints, the early learning standards from a subset of those states were selected to reflect the variation in the population and geography of the United States as well as different types of publicly funded pre-K systems. The state early learning standards in the Pre-K Content Blueprints came from Alabama, New Mexico, Ohio, Oregon, and Tennessee.\* Notably, these states’ early learning standards do not represent the early learning standards of all states.

\*Oregon’s early learning standards largely align with the Head Start ELOF standards. Alabama and Ohio have revised their early learning standards since the Pre-K Content Blueprints were initially researched and developed.

# How do skills in the domain develop between the ages of 3 and 5?

**This section presents skill definitions and developmental progressions that come from existing research literature and early learning standards in this domain.**

How to use: This section can be used to understand how the Measures for Early Success Initiative defines executive function, using a narrow definition from the research literature. It also describes challenges in executive function terminology and its use in the practice field. Finally, it presents an example of landscaping federal and state early learning standards to illustrate how the practice field often anchors to behavioral indicators of more complex skills that use executive functions.

# Executive Function Definition and Developmental Course

In the Measures for Early Success Initiative, executive function (EF) is defined as a set of mental processes located in the prefrontal cortex region of the brain used for goal-directed behavior. It is a term that originates from the cognitive neuroscience field, which has largely conducted studies with adults.

EF typically comprises the following subcomponents or simple skills:

## ● Working Memory

The ability to maintain and manipulate information over short periods of time.

## ◆ Inhibitory Control

The ability to resist distractions and temptations and suppress impulsive thoughts or behaviors.

## ■ Cognitive Flexibility/Attention Shifting

The ability to shift attention or responses between competing mental sets or rules.

## ▲ Attention Focus/Attention Control\*

The ability to voluntarily focus or sustain attention on a given task.

\*Though many EF studies specify a three-factor model comprised of working memory, inhibitory control, and cognitive flexibility/attention shifting, attention focus/attention control is included in this blueprint given that it is a closely related skill that is particularly salient in early childhood. In the early years, children's EF presents as an initial global regulatory construct that relies on attention focus. It is also difficult to untangle attention focus/attention control from EF because direct EF assessments require children to intentionally focus for the duration of the task.<sup>7</sup>

## Developmental course

There is a period of rapid growth between the ages of 3 and 5 as the prefrontal cortex of the brain matures, though development of these skills continues at a slower rate well into early adulthood.

While research with adults suggests that EF can be divided into distinct, yet interrelated, subcomponents,<sup>6</sup> research with children suggests that **EF is more of an initial global regulatory construct during the early preschool period of development,<sup>7,8</sup> that becomes more differentiated with age.<sup>9</sup>**

Differentiated EF subcomponents begin to emerge in 4- to 7-year-olds and gradually, **these EF skills are integrated with domain-specific learning to produce more complex self-regulatory behaviors.<sup>7</sup>**

## Important Note on

# Executive Function Terminology

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Before developing solutions that will measure EF as defined on the previous page, it is important to recognize that the child development **research and practice fields have often used the terms executive function, self-regulation, and other related skills interchangeably—and sometimes erroneously—which can obscure real differences in what these skills are, how they are measured, and how they are related to children’s learning and development.**<sup>10</sup>

This Content Blueprint brings together information from the research and practice fields. There are definition and measurement challenges in both.

### Research field

Because the Measures for Early Success Initiative focused on designing new direct child assessments, this Content Blueprint presents information on existing direct child assessment tools and the EF definitions they are grounded in. These measures have largely been developed and used in research settings and are often adaptations of tools originally designed for use with adults. **These tools were not designed for real-world application in early learning settings, meaning their relevance to classroom practices or programmatic decision-making is not always clear.**

### Practice field

Because real-world application is essential, early learning standards are presented for the EF domain to the extent that they have been specified in federal and state standards. However, **early learning standards often describe the behavioral manifestations of children’s use of their EF—behaviors that are more readily observable by educators—making it difficult to be certain that these standards truly represent underlying, and often more specific, EF subcomponents.** Typically, early learning standards describe more complex skills that include the use of EF, and may describe related proximal skills (such as problem solving) or distal skills (such as creativity), or both.<sup>10</sup>

These challenges are comprehensively addressed in the [Executive Function Mapping Project](#) report.<sup>10</sup> The Measures for Early Success Initiative used this framework to help map terms in this Content Blueprint. **Assessment developers are encouraged to read the report in its entirety.**

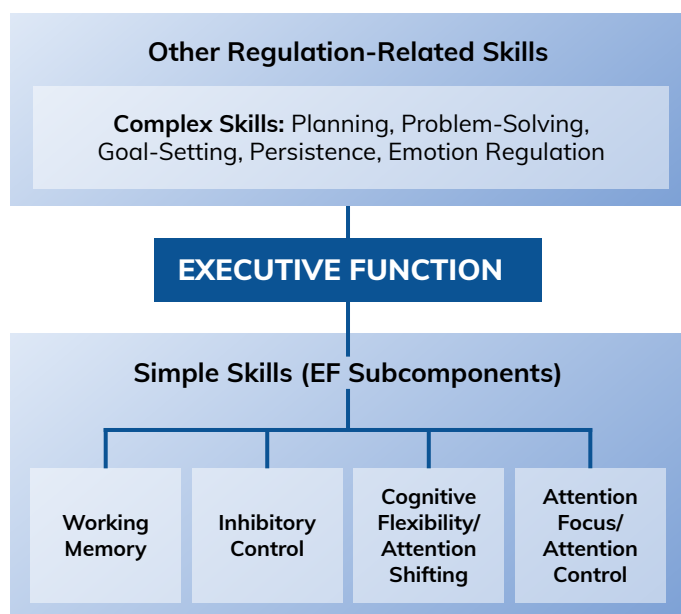
## Application of

# Executive Function Research to Practice

### More complex skills that use or incorporate EF

Regulation-related skills such as problem-solving and emotion regulation typically involve multiple EF subcomponents (simple skills) and other skills and knowledge and therefore can be described as more complex skills than EF. These are typically easier to observe because they include the behavioral manifestations of goal-directed behavior (as in, the real-world use of EF in service of goals). **Together, simple and complex skills fall under the umbrella often broadly referred to as Self-Regulation or Self-Control.**

**Umbrella Skills:** Self-Regulation, Self-Control



Source: Adapted from Bailey, Barnes, Park, Sokolovic, and Jones (2018).<sup>11</sup>

### EF and Early Learning Standards

At the time of this Content Blueprint's development, only the ELOF and Oregon (from the advisory states participating in the Measures for Early Success Initiative) had early learning standards that explicitly included a subdomain for Executive Function (that is, Cognitive Self-Regulation under Approaches to Learning).

This blueprint presents those early learning standards and developmental progressions on the following pages as an example of how EF-related terminology is applied in the early education field. **Those standards sometimes include indicators that describe more complex skills, rather than simple skills representing EF subcomponents, even if they are labeled as such.**

### Federal and select state subdomains

Head Start [Early Learning Outcomes Framework](#) (ELOF)<sup>12</sup> & [Oregon](#)<sup>13</sup>

- Working Memory
- ◆ Impulse Control
- Flexible Thinking and Behavior
- ▲ Sustained Attention
- ▲ Task Persistence

Other advisory states' early learning standards include indicators that capture similar complex skills; some of these standards are found in other domains, such as Social and Emotional Development.

Note: Visit the Head Start ELOF [Effective Practice Guide](#) to see what complex skills look like in pre-K settings and teaching practices that support children's development of EF and other regulation-related skills.<sup>14</sup>

## Executive Function Development in Early Learning Standards

# Working Memory

### SKILLS

**Holds information in mind and manipulates it to perform tasks**

### EMERGING INDICATORS

(36 to 48 months)

With the support of a trusted adult or peer, holds small amounts of information in mind, such as two-step directions, to successfully complete simple tasks.<sup>a,e</sup>

### COMPLEX INDICATORS

(by 60 months)

Often accurately recounts recent experiences in the correct order and includes relevant details. Often successfully follows detailed, multistep directions, sometimes with reminders. Often remembers actions to go with stories or songs shortly after being taught.<sup>a,e</sup>

<sup>a</sup> = ELOF (2015); <sup>b</sup> = Alabama (2020); <sup>c</sup> = New Mexico (2020); <sup>d</sup> = Ohio (2012); <sup>e</sup> = Oregon (2015); <sup>f</sup> = Tennessee (2018)

Executive Function Development in Early Learning Standards

# Inhibitory Control

**SKILLS**

**EMERGING INDICATORS**

**COMPLEX INDICATORS**

(36 to 48 months)

(by 60 months)

**Increasing ability to control impulses**

When directly supported by a trusted adult, frequently engages in impulsive behaviors, but inhibits them.<sup>a,e</sup>

With adult guidance and support, stops an engaging activity to transition to another less desirable activity with adult guidance and support. Sometimes delays having desires met, such as agreeing to wait a turn to start an activity. Without adult reminders, waits to communicate information to a group. Sometimes refrains from responding impulsively, such as waiting to be called on during group discussion or requesting materials rather than grabbing them.<sup>a,e</sup>

a = ELOF (2015); b = Alabama (2020); c = New Mexico (2020); d = Ohio (2012); e = Oregon (2015); f = Tennessee (2018)

## Executive Function Development in Early Learning Standards

# Cognitive Flexibility/Attention Shifting

### SKILLS

### EMERGING INDICATORS

### COMPLEX INDICATORS

(36 to 48 months)

(by 60 months)

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#### Flexibility in thinking and learning

Demonstrates flexibility, or the ability to switch gears, in thinking and behavior when prompted by an adult, such as trying a new way to climb a structure when the first attempt does not work.<sup>a,e</sup>

Tries different strategies to complete work or solve problems, including with other children. Often applies different rules in contexts that require different behaviors, such as using indoor voices or feet instead of outdoor voices or feet. Often transitions between activities without getting upset.<sup>a,e</sup>

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<sup>a</sup> = ELOF (2015); <sup>b</sup> = Alabama (2020); <sup>c</sup> = New Mexico (2020); <sup>d</sup> = Ohio (2012); <sup>e</sup> = Oregon (2015); <sup>f</sup> = Tennessee (2018)

## Executive Function Development in Early Learning Standards

# Attention Focus/Attention Control

### SKILLS

### EMERGING INDICATORS

### COMPLEX INDICATORS

(36 to 48 months)

(by 60 months)

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#### Maintains focus and sustains attention

With adult support, focuses attention on tasks and experiences for short periods of time, despite interruptions or distractions.<sup>a,e</sup>

Frequently maintains focus on activities for extended periods of time, such as 15 minutes or more. Often engages in purposeful play for extended periods of time. With minimal support, attends to adult during large and small group activities.<sup>a,e</sup>

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#### Engages and persists in tasks

With or without trusted adult support, persists on preferred tasks when presented with small challenges, such as continuing to try to build a tall tower with blocks, even when some pieces fall.<sup>a,e</sup>

Sometimes completes tasks that are challenging or less preferred despite frustration, either by persisting independently or seeking help from an adult or other child. Sometimes returns with focus to an activity or project after having been away from it.<sup>a,e</sup>

With encouragement from an adult, expresses the desire to take on challenges through verbal or nonverbal means. Shows some understanding that mistakes can provide information to learn from.<sup>e</sup>

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a = ELOF (2015); b = Alabama (2020); c = New Mexico (2020); d = Ohio (2012); e = Oregon (2015); f = Tennessee (2018)

# What are domain-specific opportunities for innovation?

**This section provides examples that are specific to the development of assessment tools in this domain.**

How to use: This section should be used to reflect on the current state of assessment in this domain and to identify potential opportunities for innovation in this domain. However, these examples are not exhaustive.

# Centering User Perspectives in Assessment Design

Given the broad range of families and children served by publicly funded pre-K programs, the [Centering User Perspectives in Assessment Design](#) resource was created to ensure that the decision-making used to develop and design early learning assessments focuses on the perspectives, challenges, and context of those who will ultimately use the tools in pre-K programs and systems.<sup>4</sup>

Assessment developers are encouraged to use that resource and this Content Blueprint to:

**Expand the types of skills that are measured to capture the strengths and capabilities of all children.**

**Explore how children might demonstrate these skills in different ways.**

**Innovate approaches to address key user considerations in new assessments in this domain.**

**Consider the progress of existing tools in this domain—as well as any new tools—in advancing toward the goals outlined in the *User-Informed Principles*.**

## Review the goals in the [User-Informed Principles](#)



GOAL 1  
**Content**



GOAL 2  
**Psychometrics**



GOAL 3  
**Experience**



GOAL 4  
**Usefulness**



GOAL 5  
**Scalability**

# Examples of Opportunities

The examples on this page can be used to reflect on the current state of executive function assessments and to identify potential opportunities for innovation in the executive function domain.

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**Current state:** Most direct assessments of EF occur in quiet, one-on-one testing situations that are not ecologically valid (not representative of the conditions under which children must regulate their attention, behavior, and emotions on a regular basis).<sup>15, 16</sup>

**Gap:** EF development is likely context-specific, emerging as an adaptation to the environment for specific goal-directed learning and behavior.<sup>17</sup>

**How can EF assessments be integrated into goal-directed, play-based opportunities, designed with contextually relevant paradigms or scenarios?**

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**Current state:** Many existing EF assessment tools are designed to try to capture an individual EF subcomponent, yet they often still require multiple subcomponents to complete.<sup>16</sup>

**Gap:** In the early preschool years, EF likely emerges as an initial global regulatory construct that begins to differentiate into distinct, yet related, subcomponents in late preschool and middle childhood.<sup>7</sup>

**How can EF assessments be designed to capture children's initial global regulatory abilities, as well as the emergence of distinct subcomponents of EF?**

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**Current state:** EF tasks often require the use of skills in other domains that may be reflected in children's EF scores yet are rarely recognized by assessment developers (such as, children's receptive language skills that are needed to ensure that they understand instructions).<sup>16</sup>

**Gap:** This measurement impurity may be unavoidable in young children because the basic skills needed to complete EF tasks are also still developing.

**How can the assessment of EF be integrated with the assessment of other domains of learning, such as math or language?**

# Examples of Opportunities (cont'd)

The examples on this page can be used to reflect on the current state of executive function assessments and to identify potential opportunities for innovation in the executive function domain.



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**Current state:** Children’s performance on EF tasks that use average response time or percentage of trials scored as “correct” are difficult to directly link to children’s everyday behavior.

**Gap:** Many performance-based direct assessments of EF are not optimal for differentiating among children across the full range of ability or for monitoring developmental changes in EF.<sup>16</sup>

**How can formative EF assessments be designed to help educators identify practices that will facilitate the development of or support EF skills?**

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**Current state:** Many EF assessments have been translated from English to other languages to assess a broader set of children. However, traditional forward and backward translation processes may not capture context-specific nuances that are important for the assessment of EF. Efforts to make instructions more “child-friendly” may result in instructions or prompts that are not grammatically correct when directly translated from English.<sup>18</sup>

**Gap:** It is unclear whether the translation of EF assessments into other languages enables emergent bilingual children to demonstrate their skills or impedes their performance due to incorrect or unclear translations that may confuse the child or otherwise adversely affect the child’s scores.

**How can EF assessments be designed with community members who speak the home language, rather than directly translated from English, to ensure that the protocol, prompts, and scoring methods are culturally, linguistically, and developmentally appropriate for emergent bilingual children who are being assessed?<sup>19</sup>**

# How are skills in the domain currently measured?

**This section presents a sample of direct assessments (and one questionnaire) that measure skills in this domain. An overview of each assessment is provided and some ways that each tool is aligned with the [User-Informed Principles](#) are highlighted.**

**How to use:** This section can be used to understand the current state of assessments in this domain and identify potential opportunities for innovation and improvements. These tools are elevated as examples—not exemplars—of direct assessments and questionnaires of young children’s skills in this domain.

Assessment developers should not try to replicate these tools or copy example prompts or items. Most of these tools are primarily used in research environments, whereas a central goal of the Measures for Early Success Initiative is to design direct assessments for use in pre-K settings by educators. Assessment developers should consider the needs of educators, children, families, and other assessment users when designing their tools.

Note: Assessment developers are encouraged to also refer to the [Executive Function Mapping Project Measures Compendium](#), which describes additional assessments of EF and other regulation-related skills in early childhood.<sup>11</sup>

# Two Common Measurement Approaches

## Direct Assessment

Direct assessments are typically used in laboratory or applied research settings and are:

- highly structured, timed, performance-based tasks,
- table-top or computerized,
- completed during a single testing session in a quiet, emotionally neutral setting,
- neutral or use culture-free stimuli, and
- considered to be the gold standard method of assessment,<sup>15</sup> yet do not capture EF skills as they are deployed in the face of real-world events and constraints.

## Educator or Caregiver

### Observations/Questionnaires

Observations/questionnaires are typically used in early learning settings and:

- assess the behavioral enactment of EF skills in “everyday” contexts,
- benefit from opportunities to observe children’s behaviors in multiple contexts and index behaviors over longer spans of time than performance-based tasks, and
- are considered to be more ecologically valid but may suffer from rater and implicit bias.

## Background Information on Direct Assessments

### Origins

- EF assessments were originally developed and conducted exclusively with adults before being adapted for children.
- EF tasks were initially used in clinical contexts as a cognitive proxy for potential neurological dysfunction involving the frontal lobes of the brain.

### Today

- Child-focused EF tasks are used with typically developing children as an index of healthy neurocognitive development.
- EF performance is examined as a predictor of social and academic success.
- EF tasks are also used to assess EF deficits in children with learning or developmental delays.

## Current Measure of Executive Function

# Fish Flanker (Attention Network Task)<sup>20</sup>

<b>Subcomponent(s) Measured</b> Inhibitory control; Attention Focus/Attention Control	<b>Sample Items</b> The task includes a practice block, a fish block, and an arrows block. <u>Practice block</u> <ul style="list-style-type: none"><li>• Uses fish stimuli. Children are asked to feed the middle fish by pressing the button that corresponds with the direction that the middle fish faces (typically the arrow keys on a computer keyboard or a touchscreen), while suppressing attention to distracting flanker fish on either side of the middle fish. To remind respondents to attend to the middle stimulus, the word “middle” is visually and auditorily presented before each trial.</li><li>• Includes four practice trials: two congruent (flanker fish point in the same direction as the middle fish); two incongruent (flanker fish point in the opposite direction as the middle fish).</li><li>• Must get at least three correct (75 percent) to advance to the test trials.</li></ul> <u>Fish block</u> <ul style="list-style-type: none"><li>• Includes 25 fish trials: 16 congruent and 9 incongruent trials presented in a pseudorandom order (with 1 to 3 congruent trials preceding each incongruent trial).</li></ul> <u>Arrows block</u> <ul style="list-style-type: none"><li>• Children who get five or more of the nine incongruent Fish trials advance to the Arrows block.</li><li>• Includes 25 arrows trials: 16 congruent and 9 incongruent trials presented in a pseudorandom order (with 1 to 3 congruent trials preceding each incongruent trial).</li></ul>	<b>Scoring</b> <ul style="list-style-type: none"><li>• Raw output includes accuracy and response time on each trial in the Fish and Arrows blocks. Accuracy can be used with children while reaction time is better suited for adults; adults reach a ceiling on accuracy so there is no variance in accuracy scores.</li><li>• The typical output score is an accuracy score equal to the percentage correct on incongruent trials.</li><li>• Scoring on the NIH Toolbox Flanker task is based on a 2-vector scoring method that uses accuracy and reaction time. Both accuracy and reaction time are given a score between 0 and 5, and these scores may be combined to create a computed score between 0 and 10. Accuracy is considered first; if an individual answers fewer than 80 percent of the trials correctly, the computed score is only the accuracy score. If more than 80 percent of the items answered are correct, the computed score is the combined accuracy and reaction time vector. For more detail on computing vector scores, see the NIH Toolbox Scoring and Interpretation Guide.<sup>23</sup></li></ul>	<b>Alignment with the User-Informed Principles</b>  <b>GOAL 1: Content Strengths</b> <b>Domain coverage:</b> The Flanker task provides output scores to capture inhibitory control and attention focus. By examining both accuracy and response time, the task can capture wider variability in scores.  <b>GOAL 2: Psychometric Strengths</b> <b>Reliability:</b> Demonstrated excellent developmental sensitivity across childhood and excellent test-retest reliability among 3- to 7-year-olds.  <b>Comparisons:</b> Demonstrated excellent convergent validity with the Wechsler Preschool and Primary Scale of Intelligence, Third Edition (WPPSI-III) Block Design subtest among 3- to 7-year-olds. <sup>24</sup>
<b>Age Range</b> Ages 3 to adult			
<b>Language Version(s)</b> English; Spanish translation			
<b>Administration</b> <ul style="list-style-type: none"><li>• The task is included in the NIH Toolbox Cognition Battery (CB). Adapted from the Eriksen flanker task (adult version)<sup>21</sup> and the Attention Network Test (child version).<sup>22</sup></li><li>• In the flanker task, participants are shown a set of five objects; children (ages 3 to 7) are shown fish and adults (ages 8 to 85) are shown arrows. Using the arrow keys on a computer or the arrows presented on an iPad screen, respondents indicate the left-right orientation of the middle object. The stimuli on either side of the middle object may be pointing in the same direction as the middle object or in the opposite direction, requiring respondents to ignore incongruent and distracting information.</li><li>• The Toolbox Flanker is administered one-on-one with each child.</li><li>• The task is a computer-administered assessment.</li><li>• An assessor is required to start the program and advance screens for the child.</li><li>• The task takes approximately three minutes per child to complete.</li></ul>			

## Current Measure of Executive Function

# Hearts and Flowers (Dot Task)<sup>25</sup>

### Subcomponent(s) Measured

Inhibitory Control;  
Cognitive Flexibility

### Age Range

Ages 4 to adult

### Language Version(s)

English; Spanish  
translation

### Administration

- The Hearts and Flowers Task is an adaptation of the Dots Task.<sup>25</sup>
- In the Hearts and Flowers task, a color picture of either a heart or a flower is presented on the left or right side of a computer screen.
- The task is administered one-on-one with each child.
- The task is a computer-administered assessment.
- An assessor is required to start the program and advance screens for the child.
- The task takes approximately 7 to 10 minutes per child to complete.<sup>26</sup>

### Sample Items

During the assessment, participants use the X and M keys to select the location that either matches or is opposite the location of the images of hearts and flowers that are flashed on the screen. The task includes a congruent block, an incongruent block, and a mixed block.<sup>27</sup>

#### Congruent block

- An image of a red heart is presented on the left or right side of the screen. If the heart is displayed on the left, respondents should press the X button (left). If the heart is displayed on the right, respondents should press the M button (right). For the rest of the task, whenever a heart is displayed, the participant's response should match the left-right orientation of the heart.
- Eight heart practice trials: correction and praise is permitted.
- 12 heart test trials: correction or praise is not permitted.
- The congruent block measures baseline performance for classic choice reaction to a location.

#### Incongruent block

- An image of a red flower is presented on the left or right side of the screen. If the flower is displayed on the left, respondents should press the M button (right). If the flower is displayed on the right, respondents should press the X button (left). For the rest of the task, whenever a flower is displayed, the participant's response should be the opposite of the left-right orientation of the flower.
- Eight flower practice trials: correction and praise is permitted.
- 12 flower test trials: correction or praise is not permitted.
- The incongruent block presents a condition where the image location interferes with instructions from the previous block. To successfully move through the incongruent block, respondents have to more carefully control their responses and ignore the primed reaction to respond congruently.

#### Mixed (task switching) block

- In 33 mixed test trials, respondents play both games at once without an opportunity to practice. The respondent must flexibly switch between the two previous rules, depending on whether the stimulus is a heart or flower.
- When a heart is shown, respondents should press the corresponding key. When a flower is shown, they should select the opposite key.
- Correct and praise is not permitted.

### Scoring

- Raw output includes accuracy and response time on each trial in the Congruent, Incongruent, and Mixed blocks.
- An output score for inhibitory control is an accuracy score equal to the percentage correct on 12 trials in the Incongruent block. A higher score indicates greater inhibitory control. A second output score for inhibitory control is the average reaction time for the correct trials in the Incongruent block. A lower score (faster speed) indicates higher inhibitory control.
- An output score for cognitive flexibility is an accuracy score equal to the percentage correct on the 33 trials in the Mixed block. A higher score indicates greater cognitive flexibility. A second output score for cognitive flexibility is the average reaction time for the correct trials in the Mixed block. A lower score (faster speed) indicates higher cognitive flexibility.<sup>26</sup>

### Alignment with the User-Informed Principles

#### GOAL 1: Content Strengths

**Domain coverage:** The Hearts and Flowers task provides output scores to capture inhibitory control and cognitive flexibility. By examining both accuracy and response times, the task can capture wider variability in scores.

## Current Measure of Executive Function

# Minnesota Executive Function Scale (MEFS)<sup>28</sup>

<b>Subcomponent(s) Measured</b> Cognitive Flexibility	<b>Sample Items</b> <ul style="list-style-type: none"><li>• During the assessment, children are asked to sort a series of cards into two boxes. Each round has specific sorting rules, and the difficulty of the sorting rules increases over time.</li><li>• For example, children are shown two boxes: one with a green rabbit on the front and the other with a pink pig on the front. In a given round, the rule may be to sort by shape, and when shown a virtual card with a green pig on it, the child has to ignore the color and correctly sort into the pig box.<sup>29</sup></li><li>• Each of the seven levels has two parts. Part A has one rule and Part B introduces a second rule.</li></ul>	<b>Scoring</b> <ul style="list-style-type: none"><li>• The starting point for the MEFS is determined by a child's age, but the assessment is adaptive to the child's abilities.<sup>29</sup></li><li>• Each of the items is automatically scored, and children only move on to the next level if they correctly answer four of the five trials. If the child is unable to pass their initial age-based level, they are automatically shown easier levels until their current level of executive functioning is established.</li><li>• Scores are based on both accuracy and response time.</li></ul>	<b>Alignment with the User-Informed Principles</b> <hr/> <b>GOAL 1: Content Strengths</b> <b>Domain coverage:</b> The MEFS provides an output score that incorporates accuracy and response times, thus capturing wider variability in scores.  <b>GOAL 2: Psychometric Strengths</b> <b>Reliability:</b> The MEFS is normed with over 51,000 neurotypical children ages 2 to 17.9, most recently in 2021.  <b>Comparisons:</b> The MEFS demonstrates high convergent validity; it is significantly correlated with other EF assessments, such as the HTKS and the NIH Toolbox Cognitive Battery.  <b>GOAL 3: Experience Strengths</b> <b>Child experience:</b> The MEFS is highly adaptive to the child's abilities and provides a basal level and ceiling level to determine the child's current level of functioning.  <b>Educator experience:</b> On average, the MEFS takes about 4 minutes complete and is easy to train educators on.
<b>Age Range</b> Ages 2 to adult			
<b>Language Version(s)</b> English; Translated to 16 languages (including Spanish)			
<b>Administration</b> <ul style="list-style-type: none"><li>• The MEFS is administered one-on-one with each child.</li><li>• The task is a digitally-administered assessment and can be completed on a tablet.</li><li>• An assessor is required to start the program and advance screens for the child.</li><li>• The task takes approximately 2 to 7 minutes per child to complete, with an average completion time of 4 minutes.</li></ul>			

## Current Measure of Executive Function

# Head Toes Knees Shoulders—Revised (HTKS-R)<sup>30, 31</sup>

### Subcomponent(s) Measured

Not applicable as this is a global measure of behavioral self-regulation

### Age Range

Ages 3 to 8

### Language Version(s)

English; Translated into 28 languages (including Spanish)

### Administration

- HTKS-R is administered one-on-one with each child.
- The task is not a computerized assessment; it requires the child to respond verbally in an “Opposites” section (included as a downward extension for use with 3-year-olds) or using gross motor movements in later sections, similar to a Simon Says game.
- The task takes approximately 5 to 7 minutes to administer.

### Sample Items

#### Part 0

- Four practice items and seven test items: Children are asked to say the opposite of what the assessor says. (“If I say toes, you say head.”)

#### Part 1

- Four practice items and ten test items: Children are asked to do the opposite of what the assessor says for one set of commands. (“If I say touch your toes, you touch your head.”)

#### Part 2

- Four practice items and ten test items: Children are asked to do the opposite of what the assessor says with a second set of commands. (“If I say touch your knees, touch your shoulders. If I say touch your toes, touch your head.”)

#### Part 3

- Four practice items and ten test items: Children are asked to do the opposite of what the assessor says, but the pairs of commands are switched. (“Now, toes go with shoulders, and knees go with head.”)

### Scoring

Incorrect items are scored as 0, self-corrected responses are scored as 1, and correct responses are scored as 2. Total scores range from 0 to 118.

### Alignment with the User-Informed Principles

#### GOAL 1: Content Strengths

**Domain coverage:** The HTKS-R version has been shown to reduce floor effects in young children.

#### GOAL 3: Experience Strengths

**Child experience:** Children find the task fun and enjoyable, given its interactive administration and the silliness of doing the opposite of what the assessor instructs.

#### GOAL 5: Scalability Strengths

**Cost:** The HTKS-R requires no special materials to administer and can be used (for research purposes), free of charge.

## Current Measure of Executive Function

# Behavior Rating Inventory of Executive Function–Preschool (BRIEF-P)<sup>32</sup>

### Subcomponent(s) Measured

Inhibitory Control; Working Memory; Cognitive Flexibility (also complex skills: Emotional Control, Plan/Organize)

### Age Range

Ages 2 years through 5 years 11 months

### Language Version(s)

English; Spanish translation (this version only uses English norms)

### Administration

- The BRIEF-P is a questionnaire designed to measure the executive functioning of preschoolers in a standardized way. It is not a direct assessment.
- Teachers, parents, and daycare providers complete a paper and pencil questionnaire, rating a child's executive functioning within the preschool or home environments.
- The clinical scales form three broad indexes (Inhibitory Self-Control; Flexibility; and Emergent Metacognition) and one composite global score (Global Executive Composite).
- The BRIEF-P also provides two validity scales (Inconsistency and Negativity).
- The form includes 63 items and takes 10 to 15 minutes to complete.

### Sample Items<sup>33</sup>

Example working memory scale items:

- When given three things to do, remembers only the first or last.

Example inhibit scale items:

- Is unaware of how his/her behavior affects or bothers others.

Example flexibility scale items:

- Becomes upset with new situations.

### Scoring

- Each item is rated in a Likert scale ranging from whether the behavior is Never, Sometimes, or Often a problem in the past six months.<sup>34</sup>
- Paper and pencil administration, with online administration and scoring available.

### Alignment with the User-Informed Principles

#### GOAL 1: Content Strengths

##### Domain coverage:

The BRIEF-P measures multiple aspects related to EF including Inhibit, Shift, Emotional Control, Working Memory, and Plan/Organize which create three broad indexes (Inhibitory Control, Flexibility, and Emergent Metacognition) and one global composite score.

#### GOAL 2: Psychometric Strengths

**Reliability:** Normative data are based on child ratings from 460 parents and 302 teachers from urban, suburban, and rural areas, reflecting 1999 U.S. Census estimates for race and ethnicity, gender, socioeconomic status, and age.

Demonstrates high internal consistency reliability (0.80–0.95 for the parent sample and 0.90–0.97 for the teacher sample) and moderate test-retest reliability (0.78–0.90 for the parent sample and 0.64–0.94 for the teacher sample).

**Comparisons:** Demonstrates convergent and discriminant validity with other measures of inattention, hyperactivity/impulsivity, depression, atypicality, anxiety, and somatic complaints.

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# Notes and References (cont'd)

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