



WHAT ARE EXECUTIVE FUNCTIONS?



Executive functions (EFs) are known as the “air traffic control” of the brain—cognitive processes and abilities that are important for organizing information, planning, solving problems, sustaining attention, and orchestrating thought and action in support of goal-directed behavior. EFs are central to a child’s ability to learn how to learn.

The foundation of EFs include:

- **Working memory**—holding and updating information while simultaneously performing an operation or activity
- **Inhibitory control**—the inhibition of automatized response while working to complete a task
- **Cognitive flexibility**—the ability to adjust habitual responses or thinking and adapt to new situations or stimuli

Working memory, inhibitory control, and cognitive flexibility support the development of more complex forms of cognition, including problem solving, self-monitoring, and long-term planning skills.



A child in Kenya engages with the Arrows task, which assesses inhibitory control and cognitive flexibility.

Why Study Executive Functions?

EFs develop from infancy through adulthood, and early childhood is an initial period of rapid organization and change. Consensus is growing that early and persistent poverty undermines children's social and academic outcomes, in part through poverty's negative impacts on executive functioning. However, because almost all studies of EFs in early childhood have focused on children in high-income countries (HICs), a knowledge gap exists for low- and middle-income countries (LMICs), where children experience such poverty.

What is EF Touch?

EF Touch is a battery of tasks that measures inhibitory control, working memory and cognitive flexibility. Because of a lack of scalable and easy-to-deploy assessments, much of what is known about EF has been gleaned from HICs. EF Touch is unique in that its platform within RTI's Tangerine® software enables easy-to-use and scalable assessment, even within LMIC contexts.

Some of the assessment tools included in EF Touch are as follows:

- **Bubbles** (simple reaction time): Children are presented with a series of blue bubbles, one at a time, and they are instructed to touch the tablet screen to “pop” each bubble as fast as they can.
- **Silly Sounds Stroop** (inhibitory control): Children play a silly game that involves touching the picture of the animal that did not make the sound (e.g., when both a dog and cat are shown, touching the cat when hearing the dog bark).
- **Spatial Conflict Arrows** (inhibitory control and cognitive flexibility): Children are instructed to touch the button to which an arrow is pointing. Arrows appear above the button (congruent condition), above the opposite button (incongruent condition), or in mixed locations.
- **Pick the Picture** (working memory): Children are presented with various arrays of pictures. For each set, the children initially are instructed to touch any picture of their choice. Pictures are then presented in various locations, and children are instructed to pick a picture that has not yet been touched.

Where has EF Touch been tested?

In 2017, EF Touch was piloted in Nairobi, Kenya, its first deployment in an LMIC on a tablet device using RTI's Tangerine® software. It was administered mainly in Kiswahili to 3- to 6-year-old children. Overall, the pilot successfully demonstrated the feasibility of using EF Touch to measure these skills in young children in an LMIC context. RTI researchers submitted a paper on the pilot study's results to a peer-reviewed publication in November 2017, and have incorporated the tool into the longitudinal data collection for the Tayari Early Childhood Development Programme in Kenya, with data collection from 1,300 children in progress.

What are next steps for EF Touch?

RTI International is seeking partners to assist in systematic studies of EF Touch in other LMICs, with the expectation that modified versions will yield valuable information related to early education policy and practice. To the extent that individual differences in EFs in preprimary grades contribute to children's successful transition to primary schooling, efforts to improve EFs during the preprimary period may become an important new education objective. Similarly, a clear need exists for sound and valid measures of children's early cognitive abilities, which could be used in epidemiological studies and program evaluation efforts related to the impacts of early-life nutrition or responsive caregiving interventions, for example.

EF Touch is an exciting new tool that has proven effective at gathering relevant EF data. It is the first to be easy to use and scalable, while producing results that accurately identify EFs in young children. Continued research in this area could help solidify the reliability and validity of EF measures in LMICs and inform policy questions related to early childhood programming and pedagogy.

More Information:

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