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Much ado about generalization? What convenience samples can—and cannot—tell us about executive function development

Sabine Doebel
George Mason University
sdoebel@gmu.edu

Executive function (EF) is a core capacity of the human mind and brain that allows us to think before we act and select behaviors that align with our goals, knowledge, values, and social norms. EF develops dramatically in childhood, yet much remains unknown about how it develops, stymying efforts to train and improve it and associated outcomes. The [Monograph](#) by McCraw and colleagues reports results from a longitudinal study using a convenience sample of twenty middle/upper-middle class children from Tennessee (100% white, 60% female), finding that 54-month-olds' EF performance on the Dimensional Change Card Sort (DCCS) can be predicted from neural activity recorded during labeling and dimensional knowledge tasks when the children were 30 months old. The authors conclude that dimensional label learning impacts the development of EF, consistent with the dynamic field theory of EF. McCraw and colleagues consider the findings to be particularly promising for interventions because dimensional label learning should have more potential for cognitive transfer than practicing specific EF skills.

This commentary focuses on a question that is increasingly pressing in the field: To what extent should we expect these findings—and others involving convenience samples—to have relevance for understanding the development of EF in children who may not share many of the characteristics or experiences of children in the sample? In McCraw et al.'s monograph, the participant sample is relatively small at twenty children and is also homogeneous in race and regional representation. The authors note that the sample size and demographics are key limitations of their study—challenges common in cognitive neuroscience, which is time-intensive for participants and resource-intensive for researchers. (The sample was initially more diverse before attrition.) Yet despite these limitations the authors also state that the study has important implications for understanding EF development as well as for intervention. The implication seems to be that although this was a small convenience sample, we should expect—or at least be optimistic—that the results provide insights into EF development broadly.

But should we?

A key issue is that the primary task used to measure EF may not be as meaningful for children with different backgrounds and experiences from those in the study. The DCCS has been cast as an optimal measure to track EF development, but it likely also reflects and measures culturally specific knowledge and skills. As such, lower DCCS scores may reflect a mismatch with the child's experiences and context, not necessarily poor EF capacity.

It is worth reflecting a bit on why the DCCS is such a widely used measure of EF. The task has face validity for many researchers as an assessment of the ability to flexibly shift how one is thinking about a problem or task and shares a strong resemblance with the Wisconsin Card Sorting Task, another widely used task that was adapted as a measure of EF in adults with frontal lobe injuries (Milner, 1963). It is also robustly correlated with age (Doebel & Zelazo, 2015) and contemporaneously developing skills (e.g., social reasoning skills, Devine & Hughes, 2014) and predicts a broad range of outcomes (Spiegel et al., 2021; Stucke & Doebel, 2024). As a result, the DCCS has been viewed as a general measure of EF ability.

Yet the DCCS, like other widely used EF measures, draws on many culturally specific experiences (Doebel, 2020; Doebel & Lillard, 2023; Gaskins & Alcala, 2023; Miller-Cotto et al., 2021). For example, on this task, children use EF in response to a particular kind of external cue—an adult experimenter's instructions. They also leverage specific conceptual knowledge related to various dimensions or categories that are often emphasized in Western middle-class homes (color, shape, animals, etc.) to represent the current task goal, and to notice the conflict between pre-switch and post-switch sorting rules (Doebel & Zelazo, 2016). In addition, specific language skills may allow children to explicitly represent the task structure, which may play a role in recognizing and resisting the habit of sorting by the old rules (Doebel & Zelazo, 2016; Kuhn et al., 2016).

Many young children, within and beyond the US, grow up in communities in which these particular skills may not be consistently encouraged, for various reasons. Often these children are described as having poor EF, or EF “deficits”, due to putative lower quality home environments (e.g., Andrews et al., 2012; Rosen et al., 2020). This kind of perspective emphasizes limited access to resources as a barrier to encouraging EF skill development yet fails to acknowledge that families and communities can also differ in what they value and prioritize, which then manifests in how children use and develop EF skills (Miller-Cotto et al., 2021).

If the goal is to understand the development of EF as a foundational and potentially universal capacity, ability or set of skills, measures that are used with diverse populations of children should truly equate for cultural knowledge and values that could affect performance, which will likely involve a lot more than augmenting existing tasks (Gaskins & Alcala, 2023; Miller-Cotto et al., 2021).

If, on the other hand, the goal is to understand the emergence of specific EF skills as assessed by a task like the DCCS (which we know correlates with various developmental skills and outcomes), then this should be made explicit, and it should be recognized that cultural knowledge and values likely affect the emergence of these skills. On this view, what the authors refer to as a “learning mechanism” of EF development may be better described as cultural

3 Doebel

experiences that support using EF in this way (Doebel, 2020), which ultimately may or may not foster EF development more broadly.

I have argued elsewhere that convenience samples can and should continue to have a place in developmental psychology, particularly as newer approaches to data collection promise to broaden these samples and allow for analyzing heterogeneity in them (Doebel & Frank, 2023). However, it remains critical to constrain generalizations appropriately, which should be reflected not only in sections of a research report that directly address limitations but also in the statements about the study's implications that are made throughout.

The research by McCraw and colleagues is exciting and novel as it provides insights about the specific linguistic experiences and neural activity that support using EF in the way that is assessed by the DCCS, which we know is relevant to many developmental outcomes in some cultural contexts. The study is rare in the current wave of EF research in its aim of testing a theorized mechanism of EF development, and in demonstrating relations between labeling experience and later DCCS performance in a longitudinal cohort. A crucial next step in understanding EF development more broadly is to reflect further on what other ways EF skills could be measured meaningfully in diverse populations, what specific experiences might support such skills and whether this coheres or contrasts with the current findings.

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