Challenging socioeconomic status: A cross-cultural comparison of early executive function

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Research Highlights

- Research demonstrating an SES gradient of executive function derives primarily from high income countries
- We compared executive functions of 1,092 preschoolers in South Africa and Australia
- Low-income South African children outperformed comparatively higher SES Australian children on two of three EFs
- Suggests the possibility of EF-protective and -promotive practices in low- and middle-income countries

Abstract

The widely and internationally replicated socioeconomic status (SES) gradient of executive function (EF) implies that intervention approaches may do well to extrapolate conditions and practices from contexts that generate better child outcomes (in this case, higher SES circumstances) and translate these to contexts with comparatively poorer outcomes (often low-SES populations). Yet can the reverse also be true? Using data from equivalent assessments of 1,092 pre-schoolers' EFs in South Africa and Australia, we evaluated: the SES gradient of EF within each sample; and whether this SES gradient extended cross-culturally. The oft-found EF-SES gradients were replicated in both samples. However, contrary to the inferences of EF-SES associations found nationally, the most highly disadvantaged South African subsample outperformed middle- and high-SES Australian pre-schoolers on two of three EFs. This suggests the possibility of EF-protective and -promotive practices within low- and middle-income countries that may aid understandings of the nature and promotion of EFs.

Keywords: executive function, preschool, socioeconomic status, SES, disadvantage, LMIC

Introduction

Socioeconomic status (SES) is a ubiquitous factor influencing child development. In this context, SES characterizes resources (e.g., disposable income, housing), opportunities (e.g., employment), access (e.g., health care, education), and environmental risks (e.g., substance abuse, violence, criminality) that can alter lifetime trajectories for intellectual, behavioural, social-emotional, and health outcomes (e.g., Conger & Donnellan, 2007; Evans, Chen, Miller, & Seeman, 2012; Heckman, 2006). Indeed, meta-analyses of the predictive power of SES show associations with: academic achievement and mental well-being in childhood (Letourneau, Duffett-Leger, Levac, Watson, & Young-Morris, 2013; Sirin, 2005); adolescent substance use, physical health, and mental health (Quon & McGrath, 2014); and substance use, health, and premature death in adulthood (Stringhini et al., 2017).

Yet SES is a complex construct, conflating more- (e.g., parenting practices, education) and less-modifiable factors (e.g., financial position, environmental risk, access to services). For this reason, intervention programs have sought to identify modifiable factors that protect against negative trajectories and promote better life outcomes, such as high quality pre-school (Sammons, Elliot, Sylva, Melhuish, Siraj-Blatchford, & Taggart 2013), parental investment and practices (Hoff, Laursen, & Tardif, 2002), and early cognitive capacities that contribute to later-life outcomes (i.e., executive functions; Dilworth-Bart, 2012; Fitzpatrick, McKinnon, Blair, & Willoughby, 2014). The promise of executive functions (EFs) for narrowing SES-related achievement gaps is supported by evidence that: (1) early EF contributes to a broad array of life outcomes (intellectual, behavioural, health, vocational, social), through their role in resisting impulses and distraction, working with information in mind, and flexibly shifting thinking with situational demands; and (2) EF is malleable through everyday activities, with some gains transferring to better real-world outcomes (Diamond, 2013). Indeed, an EF-SES gradient exists in high-income countries (HICs; Hackman, Gallop, Evans, & Farah, 2015), as well as within low- and middle-income countries (LMICs; Fernald, Weber, Galasso, & Ratsifandrihamanana, 2011), suggesting that SES-related achievement gaps may be mitigated through EF-boosting strategies.

Yet the demonstrated SES-gradient of EF is derived almost exclusively from within-country investigations. Does it manifest as robustly and reliably cross-culturally, such that EFs are comparatively lower in LMICs compared to HICs? Or might there be implications from LMIC-based research that can illuminate (e.g., identify novel patterns that are not found in HICs); qualify (e.g., contrast research suggesting that SES is universally adverse for EFs); or strengthen assumptions on the nature and development of EF (e.g., provide evidence from a LMIC of novel EF-protective factors)? Evidence supporting this proposition is sparse (e.g., Fernald et al., 2011), yet suggests the possibility of EF-protective and -promotive practices that are more embedded, low-cost, and routine (given resources constraints in these contexts) than expensive and time-consuming alternatives pervasive in HICs (e.g., computerized brain training; Owen et al., 2010). As such, to explore possible between-country differences in EFs, we leveraged existing data from a LMIC context (townships, villages, and suburban areas in South Africa) and a HIC context (low-, middle- and high-SES areas in Australia) that adopted the same EF measures. In doing so, we evaluated the under-researched question of whether the SES gradient of EF, routinely found nationally, was replicated cross-culturally.

Methods

Participants

Participants were 1,092 3-5-year old children attending preschool from low- (quintile 1), middle- (quintile 3) and high-SES (quintile 5) contexts, drawn from existing studies in three non-adjacent provinces of South Africa (n = 155; M_{age} = 4.43, SD = 0.71, range = 3.02 - 5.99; 50% girls) and four states in Australia (n = 937; M_{age} = 3.96, SD = 0.68, range = 3.01- 5.96; 47% girls) that adopted the same EF measures. As a consequence of leveraging data from existing studies, data were only available for SES quintiles 1, 3, and 5 in South Africa. While we had a fuller range of SES in the Australian sample, to mirror the South African data structure we removed data for quintiles 2 and 4 from this subsample.

For all participants, SES was characterized by government area-level SES quintiles. In Australia, this was the Australian Bureau of Statistics' socioeconomic indices for areas (SEIFA), which combines census data on education, household income, and unemployment by postcode. Previous analyses have indicated that this index relates well to household-level income, health, net worth, and remoteness (ABS, 2006). In South Africa, SES quintiles for areas, which are used to classify schools, were calculated from weighted census variables including income dependency ratio and levels of education in the community. While these area-level indices of SES are limited by their attribution of the SES for an area to individuals within that area, they are strengthened by their aggregation of a broader array of factors (e.g., income, education, housing, community resourcing and access, employment type and levels, quality and access to education, etc.) Multiple factors together often generate a better index of socioeconomic means than simple income (Braveman et al., 2005). Moreover, both are government-created and derived from national census data, are in widespread use, and are well-suited to comparison given their relative (rather than absolute) quantification of SES.

As these indices are not identically calculated, explicit cross-cultural comparisons of these SES indices cannot be conducted. Yet recent data indicates significantly greater levels of disadvantage in the South African context compared to Australia. For instance, Australia's unemployment stands at 6.9%, median weekly household income is $1,068USD per week, and 99.2% live in an apartment or house equipped with electricity and internal plumbing (ABS, 2017). In South Africa, unemployment sits at 25.2%, average household income is $202USD per week, and 15.6% and 26.6% live without access to electricity or piped water in their home, respectively (STATSSA, 2014). Moreover, 13.6% occupy informal dwellings (i.e., corrugated metal shacks and other low-cost housing; STATSSA, 2014).

Indeed, despite the appearance of comparability created by SES quintiles, recent figures indicate 55.5% of South Africans live in poverty (earn less than $44USD per person/month; STATSSA, 2014). Poverty rates are far lower in Australia (13.3%; ACOSS, 2016), despite applying a higher standard of living in setting the poverty line. Also higher in South Africa are: food insecurity (20.2% in South Africa, 5% in Australia); rates of violence experienced by children (40% in South Africa, compared to 5-10% in Australia); HIV infection (12.6% in South Africa, <1% in Australia); and early school dropout (57.3%, in South Africa and 26% in Australia) (ACOSS, 2016; AIFS, 2017; Richter, Mathews, Kagura, & Nonterah, 2018; STATSSA, 2014). As such, despite an inability for direct SES comparisons between the two countries, these figures highlight stark differences in their socioeconomic realities–especially amongst the most disadvantaged communities.

Measures

In both studies, EF measures were drawn from the Early Years Toolbox battery of iPad assessments of early development (Howard & Melhuish, 2017). Specifically, in each study one measure was adopted for each of working memory (Mr. Ant), inhibition (Go/No-Go), and cognitive flexibility (Card Sort). These measures showed good validity and reliability in large preschool samples, are in use around the world, and have been translated into numerous languages (Howard & Melhuish, 2017). Translation of these assessments presented a unique opportunity for administration in the children's native language in both countries, while also standardizing the instructions, administration, and scoring via an iPad (thereby minimizing error variability associated with multiple assessors). The cultural appropriateness of these tasks with South African children was evidenced by children's successful performance of these tasks (on each task, scores at floor were present for less than 2% of cases), as well as comparable inter-task correlations with those previously reported (Howard & Melhuish, 2017).

Mr Ant. This working memory task asks children to remember the spatial locations of "stickers" placed on a cartoon ant and identify these locations after a brief retention interval. Test trials increase in working memory demand as the task progresses, with three trials at each level of difficulty (progressing from one to eight stickers). All trials progress as follows: (1) Mr. Ant presented with *n* stickers (where *n* equals the current level of difficulty) for 5 s; (2) presentation of a blank screen (retention interval) for 4 s; then (3) an image of Mr. Ant without stickers—along with an auditory prompt to recall where the stickers were—presented until the participant's response is complete. Participants respond by tapping the locations on Mr. Ant that they think previously held stickers. The task continues until the earlier of completion (at Level 8), or failure on all three trials at the same level of difficulty. Instructions and three practice trials serve to familiarize participants with task requirements. WM capacity was indexed by a point score calculated as follows: beginning from Level 1, one point for each consecutive level in which at least two of the three trials were performed accurately, plus 1/3 of a point for all correct trials thereafter.

Go/No-Go. This inhibition task asks participants to tap the screen on "go" trials ("catch the fish") and not tap the screen on "no-go" trials ("avoid catching sharks"). As the majority of stimuli are go trials (80% fish), this generates a prepotent tendency to respond, requiring participants to inhibit this response on no-go trials (20% sharks). Instructions and 20 practice trials, scaffolded into three blocks, serve to familiarize participants with the task. The task proceeds with 75 stimuli divided evenly in three test blocks (each separated by a short break and a reiteration of instructions). Each trial involves presentation of an animated fish or shark for 1,500 ms, separated by a 1,000 ms inter-stimulus interval. These stimuli are presented in pseudo-random order, such that a block never begins with a no-go stimulus and no more than two successive trials are no-go stimuli. Following Howard and Melhuish (2017), inhibition was indexed by an impulse control score that conditions proportional “no-go” accuracy (to index the child’s ability to overcome a prepotent response) by the strength of the prepotent response (which is accomplished by multiplying by proportional “go” accuracy).

Card Sort. This cognitive flexibility task asks children to sort stimuli (i.e., red rabbits, blue boats) by a sorting dimension (i.e., color or shape) into one of two locations (identified by a blue rabbit or a red boat), then switch to the alternate sorting rule. After a demonstration trial and two practice trials, children begin sorting by the first dimension for six trials. In the subsequent post-switch phase, children are asked to sort cards by the other sorting dimension, as prompted by auditory instructions preceding post-switch test trials. In all conditions, each trial begins by reiterating the relevant sorting rule and then presenting a stimulus for sorting. If the participant correctly sorts at least five of the six pre- and post-switch stimuli, they proceed to a border phase of the task. In this phase, children are asked to sort by color if the card has a black border or by shape if the card has no black border. After a demonstration trial and two practice trials, this sorting rule is reiterated prior to presenting the six stimuli for sorting. If a child fails to progress to the border condition of the task, no credit is given for these trials. Scores represent the number of correct sorts after the pre-switch phase.

Procedure

Tasks were administered by trained researchers who first spent time in the preschool to build familiarity and rapport with the children. In all contexts, assessments were administered in a separate quiet area of the preschool, to minimize disruption and distraction. Assessments were administered and automatically scored via an iPad, so as to standardize administration of the assessments across contexts. While children differed in familiarity with iPads (with anecdotally less familiarity in the low- to middle-SES South African contexts), these tasks were designed to parallel how one would respond if it were a paper and pencil task – thereby leveraging the affordances of technology while limiting potential effects of technological expertise. The tasks' practice trials also fostered familiarity with the iPad. Study protocols were approved by the universities' human research ethics committees, and participants' parents provided written consent and the child gave verbal assent to participate. All approved protocols were in accordance with provisions of the World Medical Association Declaration of Helsinki.

Results

Initial data exploration indicated that statistical assumptions were met for nearly all analytic variables, with no evident floor or ceiling effects. While there were occasional minor deviations from normality (per Shapiro-Wilk tests), these were not extreme (as indicated by $z_{skewness}$ statistics < 3). Only Card Sort for the Australian subsample showed extreme negative skew, which could not be remedied through transformation due to the prevalence of 0 scores. However, this does not reflect performance at floor per se, as pre-switch trials were routinely performed correctly by these children but were not incorporated in this index. It is notable that this extreme skew, caused by a small contingent of children who were unable to switch rules, was found only within the low- and middle-SES Australian subsamples. Nevertheless, given this skew, analyses involving Card Sort data for these subgroups are interpreted with caution. Preliminary analyses sought to investigate the SES gradient of EF within the South African and Australian samples individually. This was first analyzed with individual EF task scores, and then latent-EF factor scores derived from exploratory factor analysis (the results of which showed a reliable one-factor solution for each sample). Subsequent analyses made targeted comparisons of EFs between the two samples.

Within-Country EF by SES Quintile

Preliminary analyses sought to replicate the frequent finding of EF scores following a gradient of SES. One-way ANOVAs on Australian data supported small but significant within-country SES trends for all three EFs: working memory, $F(2,929) = 10.43$, $p < .001$, $\eta^2 = .02$, inhibition, $F(2, 904) = 13.60$, $p < .001$, $\eta^2 = .03$, and cognitive flexibility, $F(2, 920) = 7.66$, $p = .001$, $\eta^2 = .02$. For working memory and cognitive flexibility, children in quintile 5 (Q5) outperformed those in quintile 3 (Q3) and quintile 1 (Q1); the latter two did not significantly differ. For inhibition, children in Q3 and Q5 did not significantly differ, but both outperformed children in Q1. For the South African sample, SES effects were found for working memory, $F(2,154) = 14.26$, $p < .001$, $\eta^2 = .16$, and cognitive flexibility, $F(2, 153) = 6.02$, $p = .003$, $\eta^2 = .07$, such that children in Q5 (and, for working memory, children in Q3) outperformed children in Q1. SES effects for inhibition were not found in this sample, $F(2, 153) = 2.64$, $p = .075$, $\eta^2 = .03$, as scores were uniformly high across SES quintiles (although means were directionally consistent with typical SES trends). Mean improvements in EF task scores with increasing SES quintile, for each country, are reported in Table 1 and depicted in Figure 1. Replication of these analyses using EF factor scores yielded the same (yet stronger) pattern of results, with EFs higher for each increase in SES quintile (except a non-significant difference between Q3 and Q5 in the South African sample): South Africa, $F(2,152) = 14.21$, $p < .001$, $\eta^2 = .16$; Australia, $F(2,881) = 15.06$, $p < .001$, $\eta^2 = .03$. Results provided general support for the typical finding of within-country SES effects on EF.

Full Sample Regressions of EF on Country

Subsequent analyses sought to evaluate whether country was a significant predictor of EF scores, controlling for child age and gender (given minor differences in composition of the samples). Results indicated country was a significant predictor of EF scores (Table 2), although in the reverse direction to what might be expected from within-country EF-SES gradients. That is, children in South Africa performed significantly better on all EFs, even after adjusting for age and sex: working memory, $\beta = .06$, $p = .025$ (adjusted means: $M_{SA} = 1.51$, 95% CI [1.38, 1.64]; $M_{AUS} = 1.34$, 95% CI [1.29, 1.40]); inhibition, $\beta = .14$, $p < .001$

(adjusted means: M_{SA} = 0.60, 95% CI [0.57, 0.63]; M_{AUS} = 0.50, 95% CI [0.49, 0.51]); and cognitive flexibility, $\beta = .17$, $p < .001$ (adjusted means: M_{SA} = 5.26, 95% CI [4.70, 5.82]; M_{AUS} = 3.36, 95% CI [3.13, 3.58]). Age and sex were also frequent predictors of EF, such that older children outperformed younger children and girls outperformed boys.

Regressions of EF on Country in Areas of Greatest Disadvantage

Further analyses sought to evaluate whether country was a significant predictor of EF scores amongst the most disadvantaged children (Q1) in each sample, again controlling for age and gender. Despite both sub-samples being recruited from areas in the lowest 20% for SES, given qualitatively different contexts it was again expected that children in the South African sample would be more highly disadvantaged than those in the Australian sample. Results again indicated country was a significant predictor of EF scores (Table 3), and again in the reverse direction to within-country EF-SES gradients. That is, the most disadvantaged South African sample outperformed the most disadvantaged children from the Australian sample in: inhibition, $\beta = .16$, $p < .001$ (adjusted means: M_{SA} = 0.57, 95% CI [0.52, 0.62]; M_{AUS} = 0.46, 95% CI [0.44, 0.48]), and cognitive flexibility, $\beta = .14$, $p = .001$ (adjusted means: M_{SA} = 4.53, 95% CI [3.66, 5.40]; M_{AUS} = 3.00, 95% CI [2.68, 3.33]). The children from Q1 South African areas were even outperforming children from Q3 areas in Australia on inhibition, $\beta = .16$, $p < .001$ (adjusted means: M_{SA} = 0.58, 95% CI [0.53, 0.63]; M_{AUS} = 0.46, 95% CI [0.45, 0.48]), and cognitive flexibility, $\beta = .21$, $p < .001$ (adjusted means: M_{SA} = 5.46, 95% CI [4.55, 6.36]; M_{AUS} = 3.05, 95% CI [2.72, 3.37]), and top-quintile Australian children on inhibition, $\beta = .10$, $p = .020$ (adjusted means: M_{SA} = 0.55, 95% CI [0.48, 0.63]; M_{AUS} = 0.46, 95% CI [0.44, 0.48]), and cognitive flexibility, $\beta = .20$, $p < .001$ (adjusted means: M_{SA} = 6.11, 95% CI [4.79, 7.43]; M_{AUS} = 3.03, 95% CI [2.70, 3.36]). Country did not significantly predict working memory scores: $\beta = -.03$, $p = .497$ (adjusted means: M_{SA} = 1.16, 95% CI [0.95, 1.37]; M_{AUS} = 1.24, 95% CI [1.16, 1.32]).

Discussion

These results provide novel evidence that the SES gradient of EFs often found within national samples – and replicated with both samples in this study – should not be assumed to apply invariably across all social contexts. In this study, the most highly disadvantaged South African subsample outperformed even middle- and high-SES Australian pre-schoolers on two of three EFs. This contrasts the expectations implied by robust and reliable EF-SES gradients found within HICs (Hackman et al., 2015) and LMICs (Fernald et al., 2011), which have been extended to presume poorer EFs for children from LMICs (Haft & Hoeft, 2017). Yet our results suggest the possibility of EF-protective and -promotive practices within LMIC communities that could yield new insights about the nature of EF development and factors that support EFs. Indeed, the lack of a cross-cultural effect for working memory, and absence of SES gradient for inhibition in the South African sample, raise questions about unqualified extensions of EF findings from HIC samples (for example, of a universal SES gradient of EF that applies across all EFs and levels of disadvantage) to LMIC contexts.

That these findings run contrary to common presumptions is additionally highlighted by findings that stress is detrimental for EFs (Blair et al., 2011), and is more prevalent in low-SES circumstances (Worthman & Panter-Brick, 2008). While this seems to suggest higher rates of stress-reduced EFs in LMICs, extension of this principle to LMICs is complicated by findings that income inequality may affect stress levels more than income itself (Kawachi, 1997). Moreover, findings show that the negative effects of stress on EF are moderated by children's reactivity to adversity (Obradovic, 2016). That is, circumstances that lead children in poverty to become less reactive may function as a protective factor for EFs. Also, not all unpredictable early environments may impair cognitive function (especially where risks are less pronounced, immediate, proximal, and threatening); rather, they may create conditions requiring vigilance, autonomy, and adaptation – with real-world implications – which may support certain cognitive functions (Mittal, Griskevicius, Simpson, Sung, & Young, 2015). A study in Bolivia found just this; preserved EFs amongst homeless children compared to their disadvantaged peers living in homes (Dahlman et al., 2013). To explain this, Haft and Hoeft (2017) point to these children's regular opportunities for independent application of EFs. While no one recommends disadvantaged circumstances for children as a means to promote EFs, the very presence of disadvantage does not preclude deriving generalizable knowledge about EFs from these contexts. For instance, LMIC contexts may be particularly well-placed to identify factors that promote EF-resilience in the context of disadvantage, and ecologically valid activities and experiences that can engage, challenge, and extend EFs.

While the current data are unable to identify the specific causes of the comparatively higher EF scores amongst South African children, there are multiple plausible candidates for further investigation. One is the cultural practices and expectations in South Africa, which are often unanticipated by developmental EF theories derived from 'western, educated, industrialized, rich, democratic' ('WEIRD') HICs (Henrich, Heine, & Norenzayan, 2010; LeVine et al., 1996). For instance, EF advantages have been noted in collectivistic cultures (e.g., filial respect, community support and cohesion, presence of multiple caregiving adults) over individualistic cultures (Li, Vazsonyi, & Dou, 2018; Sabbagh, Xu, Carlson, Moses, & Lee, 2006). While there was no single culture or pattern of practices across all South African communities contributing to the current data, there were common and pervasive features in many of these communities (as also noted in qualitative research in similar South African communities). These included: valuing children as a resource at home (e.g., given meaningful roles and responsibilities, assisting with caring for the young, ill, and elderly); an emphasis on children respecting and obeying adults; and children experiencing pride in their domestic roles (e.g., going to the shop, cooking for the family, washing, caring for siblings) (Dawes, Bray, Kvalsvig, Kafaar, Rama, & Richter, 2004). This explicit expectation, teaching, and enforcement of norms that focus on respecting adult instructions, despite the child's own desires and impulses (Lewis, Koyasu, Oh, Ogawa, Short, & Huang, 2009), aligns well with the conditions deemed essential for EF development (e.g., constant EF challenge in real-world situations, across a prolonged period of time; Diamond & Ling, 2016). While it is inaccurate to say that all children in the South African sample were subject to the same expectations and responsibilities, this focus may nevertheless pervade South African culture (particularly low-SES communities) more than Australian communities.

Relatedly, the rituals and routines common in South African communities may also be supportive of EF development (Rybanska, McKay, Jong, & Whitehouse, 2017). In the current South African sample, the children were expected, supported, and corrected to participate in regular routines such as song and prayer or, if not, sit still, remain quiet, and sustain attention. At all times, they were also expected to behave with respect for their community and others, within culturally defined boundaries. Ritual participation has been shown to be an effective strategy for improving EFs and delay of gratification across diverse cultures, which contrasts with a devaluation of rituals in Western childrearing (Rybanska et al., 2017).

Of course, the inability to ascribe casual pathways reflects our inability to rule out all potential confounds (although these effects remained even after controlling for children's age and gender). For instance, another factor that may contribute to the cross-cultural differences in EF performance is differing levels of compliance. That is, cultural emphasis on children's obedience to adults' instructions amongst these South African children (Dawes et al., 2004) may have contributed to their higher EF scores. This assumes, however, that the Australian children were less compliant, and less willing to engage and persist with these tasks. Two things are notable in this regard. First, anecdotally this was not the case, and these tasks have been found to induce higher levels of engagement than other established measures, even with young children (Howard & Melhuish, 2017). Second, even if compliance levels were higher amongst the South African children, there would still be little doubt about their high EF; that is, compliance without the necessary EF capacity is insufficient to score well on these tasks. Instead, it would raise a question of whether estimates of Australian children's EFs may be underestimating their genuine EF capacities, as a result of non-compliance or distraction.

While further research is needed on the precursors and trajectories of EF development in LMICs, as well as replication of these results with intentional sampling in diverse SES and cultural settings, the current results show the need for this work. These studies would benefit from consideration of multi-indicator measures of SES, rather than simply household income, to best characterize available resources (Braveman et al., 2005). Further, the current analysis is limited by the data available (i.e., an area-level SES index that did not capture all quintiles; opportunistic sampling, rather than intentional sampling of distinct and diverse clusters), and would benefit from broader and more intentional sampling. Nevertheless, replication of the EF-SES gradient in the South African and Australian samples supports the suitability of this index to estimate socioeconomic means. Additionally, although the lack of further-separable clusters (beyond SES clustering) constrains generalizability of these results (e.g., whether to expect similar advantages in other low-income South African contexts), this was not an aim of the current study. Rather, even if deviations from the EF-SES gradient are due to practices and experiences in a narrow range of low-income communities, this still provides a stimulus for further investigation into the characteristics of these communities – with implications for theory, research and practice.

Potential casual factors noted above, as well as the individual, familial, and cultural factors not explored here (e.g., parental warmth and consistency, sleep, physical activity, bilingualism, having an ethnic community that one identifies with), all have supporting literatures (e.g., Bernier, Beauchamp, Bouvette-Turcot, Carlson, & Carrier, 2013; Best, 2010; Bialystok, 2015). Yet while ample research has focused on EFs in low-income contexts in

HICs, EF research has largely neglected children in LMICs. This is problematic given our (and others') evidence that the assumptions derived from findings in WEIRD countries may not be unconditionally applicable to LMIC contexts. By further exploring EF development in these contexts, findings from LMICs may in fact elucidate, provide important qualifications to, and strengthen current assumptions about the nature of EF and its development.

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Table 1

Descriptive Statistics by EF and SES Quartile, by Country

	South Africa			**Australia**		
	Q1	**Q3**	**Q5**	**Q1**	**Q3**	**Q5**
	M (SD)	M (SD)	M (SD)	M (SD)	M (SD)	M (SD)
WM	1.34 (0.68)	2.00 (0.83)	2.10 (0.97)	1.21 (0.93)	1.29 (0.89)	1.65 (0.94)
Inhibition	0.63 (0.17)	0.68 (0.22)	0.72 (0.17)	0.45 (0.23)	0.51 (0.23)	0.56 (0.21)
CF	5.07 (2.98)	6.36 (3.06)	7.41 (3.84)	2.93 (3.67)	3.18 (3.73)	4.46 (4.25)

Note. Q = SES quintile. WM = working memory. CF = cognitive flexibility. For all tasks, higher scores indicate better EF.

Table 2

Results of Full Sample Multiple Regression Analyses

	t	*P*	*β*	*F*	*df*	*p*	R^2
Working Memory				**115.82**	**3, 1079**	**<.001**	**.24**
Country (1=SA)	2.25	.025	.06				
Age	17.40	<.001	.47				
Female child	1.87	.062	.05				
Inhibition				**198.73**	**3, 1054**	**<.001**	**.36**
Country (1=SA)	5.59	<.001	.14				
Age	21.46	<.001	.54				
Female child	4.32	<.001	.11				
Cognitive Flexibility				**91.96**	**3, 1069**	**<.001**	**.21**
Country (1=SA)	6.13	<.001	.17				
Age	12.96	<.001	.36				
Female child	4.50	<.001	.12				

Note. *β* = standardized beta. Country is coded such that 0 = Australia and 1 = South Africa. Sex is coded as 0 = male and 1 = female. SA = South Africa.

Table 3

Results of Most Disadvantaged (Q1) Sub-Sample Multiple Regression Analyses

	t	*P*	β	*F*	*df*	*p*	R^2
Working Memory				**34.59**	**3, 491**	**<.001**	**.17**
Country	-0.68	.497	-.03				
Age	10.13	<.001	.42				
Female child	0.50	.614	.02				
Inhibition				**77.57**	**3, 479**	**<.001**	**.33**
Country	4.28	<.001	.16				
Age	13.51	<.001	.52				
Female child	2.56	.011	.10				
Cognitive Flexibility				**24.14**	**3, 486**	**<.001**	**.13**
Country	3.21	.001	.14				
Age	6.57	<.001	.28				
Female child	3.26	.001	.14				

Note. β = standardized beta. Country is coded such that 0 = Australia and 1 = South Africa. Sex is coded as 0 = male and 1 = female.