ADVERSITY AND RELATIVE PERFORMANCE

**How does adversity shape performance across different abilities in the same person?**

Ethan S. Young1, Stefan Vermeent1,2, Willem E. Frankenhuis1,2, Marissa Nivision3

Jeffry A. Simpson4 and Glenn I. Roisman3

1Department of Psychology, Utrecht University, the Netherlands

2Max Planck Institute for the Study of Crime, Security and Law

3Institute of Child Development, University of Minnesota, USA

4Department of Psychology, University of Minnesota, USA

**Abstract**

The idea that some abilities might be enhanced by adversity is gaining traction. For example, research leveraging the hidden talents approach has uncovered a few narrow, context-dependent abilities enhanced by exposure to adversity. Yet, in order for a field to grow, we must not dig too deep, too fast. In this paper, we compliment adaptation-based research with principled exploration. To do so, we draw on the basic insights of adaptation-based research: 1) enhanced performance manifests within individuals and 2) reduced and enhanced performance can cooccur. Although commonly assumed, these assertions are rarely tested. To do so, a variety of ability measures are needed that examine *relative* performance differences. However, rather than using adaptive-logic to predict *which* abilities are enhanced or reduced, we develop statistical criteria to help interpret three different data patterns: reduced, enhanced, and intact performance. We use these criteria to analyze data from the Study of Early Childcare and Youth Development (SECCYD) to examine how adversity shapes within-person performance across ten abilities in the Woodcock Johnson Cognitive and Achievement test battery. Our goals are to document adversity-shaped cognitive profiles, identify possible drivers of reduced overall performance, map out sets of ‘intact’ abilities, and discover new enhanced abilities. We argue that principled exploration with clear criteria can help break new ground, re-map old territory, and fuel theory development.

**How does adversity shape performance across different abilities in the same person?**

Developmental science commonly asserts that adversity-exposure during development reduces cognitive performance, an claim founded on decades of empirical findings (Duncan et al., 2017; Farah et al., 2006; Hackman et al., 2010, 2014; McLaughlin et al., 2019; Raby et al., 2015). In recent years, however, adaptation-based frameworks, rooted in the idea that adversity might enhance certain abilities, have complimented this work—and it is gaining traction (Ellis et al., 2017, 2020; Frankenhuis, Young, et al., 2020; Frankenhuis & de Weerth, 2013; Frankenhuis & Nettle, 2020). Since its inception, the goal of adaptation-based frameworks has been to inspire a more well-rounded view of adversity and its influence on abilities—one that incorporates both the struggles and strengths of people from disadvantaged backgrounds (Frankenhuis & de Weerth, 2013). As it develops, the core task of adaptation-based research is to “uncover a high-resolution map of specific cognitive abilities that are enhanced as a result of growing up under high-adversity conditions” (Ellis et al., 2017, p. 562). To uncover this map, researchers have used confirmatory study designs, which has gleaned useful insights. Yet, to cultivate growth in an emerging research program—where there is little known and much to learn—we must not dig too deep, too fast. Without complimentary approaches, exclusive use of confirmatory designs can create tunnel vision and miss new insights (Scheel et al., 2021).

In this paper, we use a complimentary approach to confirmatory research: principled exploration. Our broad goal is to contribute to drawing our map of adversity-shaped abilities. Our specific goal is to document adversity-shaped cognitive profiles in standard cognitive achievement assessment. This allows us to identify possible drivers of reduced overall performance and map out sets of ‘intact’ abilities. To do so, we draw on the essential features of adaptation-based frameworks and use them to guide our exploration into new territory and to re-map familiar ground.

**Essential Features and Empirical Insights from Adaptation-based Frameworks**

Adaptation-based research has several essential features. First, it assumes development shapes the individual, and their abilities, to fit the local environment (Frankenhuis, Young, et al., 2020). Second, because environments differ in the challenges they pose (resource-scarcity versus violence exposure), development shapes abilities according to specific challenges. Thus, one’s abilities are thought to match the challenges of one’s lived experience. These features are useful guideposts for confirmatory hypothesis generation. Using them as building blocks, it is easy to construct an intuitive bridge between an ability and an environmental challenge. For example, a researcher might identify a specific challenge posed by a dimension of adversity (e.g., threats to safety in high crime neighborhoods) and an ability needed to meet the challenge (e.g., heightened vigilance).

This approach is appealing because it forces researchers to be specific and logically tie together challenges and abilities. It has also been successful in discovering a handful of interesting adversity-enhanced abilities, especially in harsh and unpredictable environments. For example, past work has proposed that constantly changing environments (i.e., unpredictable environments) might shape the ability to track and respond to changing information. Using this logic, research build an intuitive bridge between changing environments and two abilities–attention-shifting and working memory updating—and empirical data are consistent with this logic (Fields et al., 2021; Mittal et al., 2015; Young et al., 2018). However, there are two limitations to this approach. First, previous studies are difficult to compare because they use different measures and designs. Second, the logic behind confirmatory hypotheses is easily flipped. For example, exposure to unpredictable environments is thought to reduce inhibition, or the ability to resist distractions. If threats and opportunities arise, it is important to quickly respond, rather than ignore them to focus on a long-term goal. But we can assert the exact opposite. For example, inhibition might be enhanced by unpredictable environments because it helps to focus on what is important when there are constant distractions.

Adaptation-based research has also focused on testing content, or the notion that performance should improve when the testing content matches the lived experience of people exposed to adversity. For example, Frankenhuis and colleagues (2020) hypothesized that exposure to violence might enhance reasoning about social dominance hierarchies—but not for neutral content, such as age. Their study revealed that youth exposed to more violence were equally or more accurate when asked to memorize social dominance relationships than youth exposed to less violence. Using a similar experimental paradigm, Young and colleagues (2022) examined how real world compared to abstract testing stimuli affects performance on attention shifting and working memory tests. They found that adversity-exposed youth score higher on working memory updating tasks with real world compared to abstract content. However, again, this flavor of adaptation-based research comes with caveats. For example, some studies find that conditions thought to well-matched to the lives of those from disadvantaged backgrounds actually lower performance. For example, youth from poverty tended to score lower on math items about social relations, money, and food—items thought to be particularly relevant to lived experience—compared to other math items (Duquennois, 2022; Muskens, 2019).

In light of various caveats, this body of work has generated at least two general insights. First, although it is possible for adversity to enhance performance between individuals (e.g., low versus high adversity exposure), empirical findings suggest effects mostly occur within individuals (Fields et al., 2021; Frankenhuis, de Vries, et al., 2020; Young et al., 2022). Second, enhanced performance appears to be highly context specific, e.g., depend on testing content, context, and ability type (Fields et al., 2021; Frankenhuis, de Vries, et al., 2020; Mittal et al., 2015; Nweze et al., 2021; Young et al., 2018, 2022). Yet, adaptation-based studies have studied abilities in an isolated and piecemeal fashion, in part, because confirmatory designs tend to narrow a study’s scope. This means we know little about enhanced abilities compared with the broad landscape of ability measures.

**Motivating Principled Exploration**

We believe that adaptation-based frameworks can provide useful guideposts, but one should use shovels, not scalpels, when breaking new ground. Emerging research programs have yet to lay basic groundwork for testing theories, such as auxiliary assumptions or boundary conditions (Scheel et al., 2021). Our aim is to complement adaptation-based, confirmatory research with principled exploration (Flournoy et al., 2020; Rozin, 2001). We see two benefits for doing so. The first is to re-examine established patterns with a new lens. For example, both deficit and adaptation-based perspectives assume that adversity should reduce performance on standard assessments of cognitive ability (Ellis et al., 2020; Frankenhuis, Young, et al., 2020; Hackman et al., 2010; McLaughlin et al., 2019; Ursache & Noble, 2016). Yet, these tests are often comprised of many different subtests, and may show unique patterns that diverge from widely used composite scores. The second is to feed theory with useful description. One reason why we know little about broad sets of abilities is that adaptive logic is yet to be developed for some abilities. However, the lack of such logic this does not imply the presence or absence of a functional link. An alternative approach is to explore, describe, and follow up associations between adversity and abilities to aid theory development. Therefore, we return to the map of cognitive abilities that might be shaped by adversity and ask “what territory needs exploration and which areas may need re-mapping?”

To carefully examine and interpret data in a principled exploration, it is helpful to develop inferential and statistical criteria. For example, rather than using adaptive-logic to predict *which* abilities are enhanced or reduced, we can ask what criteria are needed for evaluating and interpreting different data patterns? In addition, research typically focuses on comparing reduced versus enhanced test performance, but some abilities might remain ‘intact’ (unaffected) by exposure to adversity (Frankenhuis, Young, et al., 2020). We know little about the intact abilities of people exposed to adversity. We also know little about the drivers of reduced performance on broad and generic measures of ability. For example, deficit approaches have collapsed many abilities into composites and find that adversity exposure reduces performance. However, one possibility is that a smaller set of specific abilities are driving effects. In total, there is still much to learn about the map of adversity shape cognitive abilities. Principled exploration can complement confirmatory research in drawing this map, especially in the early stages of a new field.

**The Current Study**

We conduct a principled exploration of how adversity shapes performance on a widely-used cognitive achievement battery using longitudinal, prospective data from the Study of Early Childcare and Youth Development ([SECCYD](https://www.icpsr.umich.edu/web/ICPSR/series/00233)). Drawing on the general insights of adaptation-based research, we employ a within-person performance design to explore performance across ten abilities. This design allows us to assess how exposure to each measure of adversity are associated with *relative* performance differences across many abilities (see Figure 1). In other words, we can compare specific abilities (e.g., short-term memory performance) to overall performance (within-person average performance on all tests) to get a clear picture of how enhanced and reduced performance manifest in parallel.

We focus on adversity measures that tap two constructs: environmental harshness and unpredictability. We focus on these constructs because they feature often in adaptation-based research on cognitive abilities (Ellis et al., 2017, 2020; Fields et al., 2021; Frankenhuis, Young, et al., 2020; Mittal et al., 2015; Young et al., 2018, 2022). We use both classic and unexplored measures that capture both. For example, we leverage data from the 1990 Census about the broader ecological context, which has been used to measure the neighborhood context in the SECCYD previously (Bleil, Appelhans, et al., 2021; Bleil, Spieker, et al., 2021).

We outline two sets of criteria for evaluating results, one conceptual and the other statistical. First, our expectations change according to the conceptual framework. For example, from a traditional deficit perspective, we should expect negative overall effects of adversity. Performance on subtests should closely match the overall effect. In contrast, from an adaptation-based perspective, we expect an overall negative effect but performance for some subtests is either less reduced, intact, or even enhanced.

Our second set of criteria are statistical. Our modeling strategy allows us to quantify performance as a function of adversity in two ways. First, we can test whether the effect adversity on each subtest is different from zero using a simple slopes test. A positive and negative effect suggests enhanced and reduced performance, respectively. Second, we compare subset performance (simple slope) against overall performance (main effect of adversity across all tests), which is measured by the interaction between subtest category and adversity. This interaction term indicates whether performance is significantly more negative, less negative, or even positive compared to overall performance. For both types of effects, we can determine if they are practically equivalent to either zero (simple effect) or overall performance (main effect). Subtest performance is intact when the effect of adversity effect on a subtest is practically equivalent to zero. Using these criteria, we position ourselves to identify the key drivers of reduced overall cognitive performance, map out sets of ‘intact’ cognitive abilities, and discover (possible) enhancements.

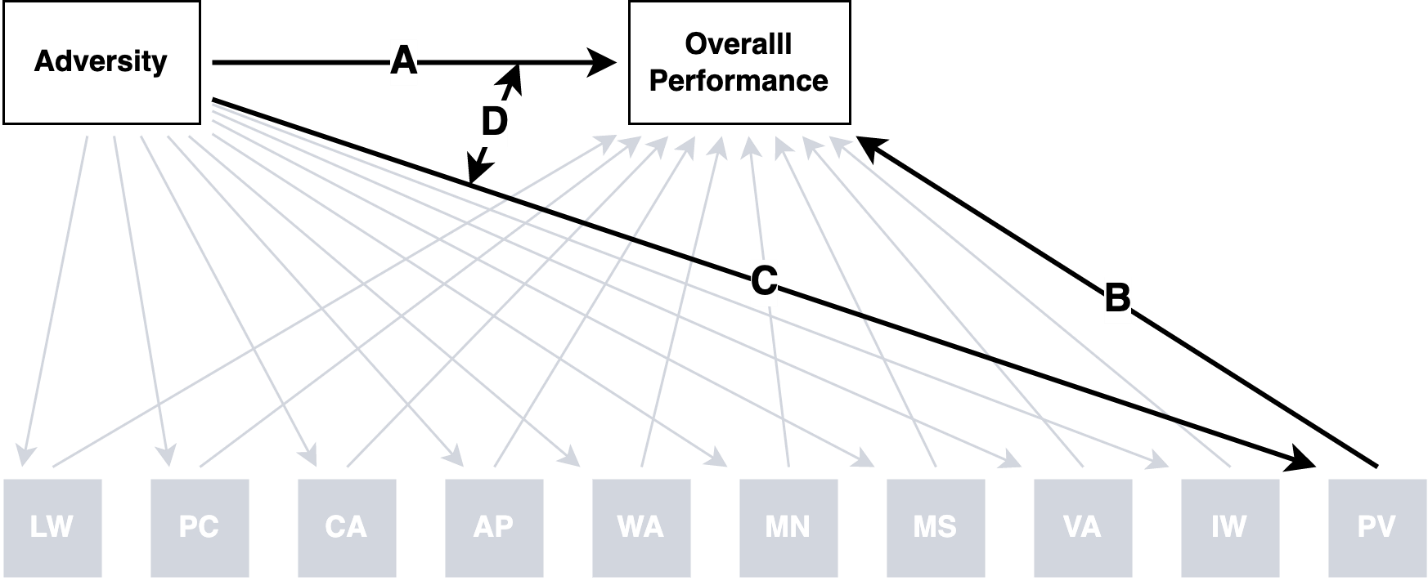


Figure 1: We are interested in the effect of each adversity measure on a person’s overall score, measured as a formative average of each subtest. (A) is the main effect of adversity on overall performance. (B) is the main effect of a subtest. (C) is the simple effect (slope) of adversity for a particular subtest. (D) is the interaction effect that measures the difference between A and C. A significant simple slope means the C ≠ 0 and a significant interaction means A ≠ C. So, when C is significant, it means that adversity affects performance. When D is significant, it means that adversity affects a subtest in a different way than A (overall pattern).

**Method**

**Participants**

Families were initially recruited for the NICHD SECCYD in 1991. A total of 1364 families met all the prescreening criteria, namely that mothers: (a) were age 18 or older, (b) did not plan to move, (c) had a newborn without any known disabilities (and could leave the hospital within one week), (d) had no history of substance abuse, (e) could speak English, and (f) lived within 1 hour driving distance from the research lab and were in a relatively safe neighborhood. More information about recruitment and selection procedures is available from the study (NICHD Early Child Care Research Network, 2005; see https://www.icpsr.umich.edu/web/ICPSR/series/00233). The current analyses included participants with non-missing data on most predictors and outcome variables through age 15 (N = 1156).

**Measures**

***Predictors***

**Unpredictability.**

**Harshness.**

***Outcomes***

**Picture vocabulary.**

* verbal comprehension/crystallized knowledge
* 5 assessments, 54 months, grades 1, 3, 5, and at 15 years

**Verbal analogies.**

* verbal fluid reasoning and crystallized knowledge
* 2 assessments, grade 3 and at 15 years

**Passage comprehension.**

* vocab and comprehension skill
* 3 assessments, grades 3, 5, and at 15 years

**Applied problems.**

* practical math problem solving skill
* 5 assessments, 54 months, grades 1, 3, 5, and at 15 years

**Memory for Sentences.**

* short term retrieval
* 3 assessments, 54 months and grades 1 and 3

**Incomplete words.**

* auditory processing
* 2 assessments, 54 months and grade 1

**Memory for names.**

* long term retrieval
* 2 assessments, grades 1 and 3

**Letter-word identification.**

* verbal knowledge
* 4 assessments, 54 months, grades 1, 3, 5

**Word attack.**

* auditory processing
* 2 assessments, grades 1 and 3

**Calculations.**

* math calculations
* 2 assessments, grades 3 and 5

**Results**

**Data Analysis Strategy**

**Primary Analyses**

**Secondary Analyses**

**Discussion**

**References**

Bleil, M. E., Appelhans, B. M., Thomas, A. S., Gregorich, S. E., Marquez, N., Roisman, G. I., Booth-LaForce, C., & Crowder, K. (2021). Early life predictors of positive change during the coronavirus disease pandemic. *BMC Psychology*, *9*(1), 83. https://doi.org/10/gk5dzv

Bleil, M. E., Spieker, S. J., Gregorich, S. E., Thomas, A. S., Hiatt, R. A., Appelhans, B. M., Roisman, G. I., & Booth-LaForce, C. (2021). Early life adversity and pubertal timing: Implications for cardiometabolic health. *Journal of Pediatric Psychology*, *46*(1), 36–48.

Duncan, G. J., Magnuson, K., & Votruba-Drzal, E. (2017). Moving Beyond Correlations in Assessing the Consequences of Poverty. In S. T. Fiske (Ed.), *Annual Review of Psychology, Vol 68* (Vol. 68, pp. 413–434). Annual Reviews. https://doi.org/10.1146/annurev-psych-010416-044224

Duquennois, C. (2022). Fictional Money, Real Costs: Impacts of Financial Salience on Disadvantaged Students. *American Economic Review*. https://doi.org/10.1257/aer.20201661

Ellis, B. J., Abrams, L. S., Masten, A. S., Sternberg, R. J., Tottenham, N., & Frankenhuis, W. E. (2020). Hidden talents in harsh environments. *Development and Psychopathology*, 1–19. https://doi.org/10/gjqwbs

Ellis, B. J., Bianchi, J., Griskevicius, V., & Frankenhuis, W. E. (2017). Beyond risk and protective factors: An adaptation-based approach to resilience. *Perspectives on Psychological Science*, *12*(4), 561–587. https://doi.org/10/gdtj9h

Farah, M. J., Shera, D. M., Savage, J. H., Betancourt, L., Giannetta, J. M., Brodsky, N. L., Malmud, E. K., & Hurt, H. (2006). Childhood poverty: Specific associations with neurocognitive development. *Brain Research*, *1110*(1), 166–174. https://doi.org/10/fv2dn8

Fields, A., Bloom, P. A., VanTieghem, M., Harmon, C., Choy, T., Camacho, N. L., Gibson, L., Umbach, R., Heleniak, C., & Tottenham, N. (2021). Adaptation in the face of adversity: Decrements and enhancements in children’s cognitive control behavior following early caregiving instability. *Developmental Science*, *24*(6), e13133. https://doi.org/10/gj7gh7

Flournoy, J. C., Vijayakumar, N., Cheng, T. W., Cosme, D., Flannery, J. E., & Pfeifer, J. H. (2020). Improving practices and inferences in developmental cognitive neuroscience. *Developmental Cognitive Neuroscience*, *45*, 100807. https://doi.org/10/gnbxdn

Frankenhuis, W. E., de Vries, S. A., Bianchi, J., & Ellis, B. J. (2020). Hidden talents in harsh conditions? A preregistered study of memory and reasoning about social dominance. *Developmental Science*, *23*(4), e12835. https://doi.org/10/ggb8qd

Frankenhuis, W. E., & de Weerth, C. (2013). Does Early-Life Exposure to Stress Shape or Impair Cognition? *Current Directions in Psychological Science*, *22*(5), 407–412. https://doi.org/10/f5cxhb

Frankenhuis, W. E., & Nettle, D. (2020). The Strengths of People in Poverty. *Current Directions in Psychological Science*, *29*(1), 16–21. https://doi.org/10/ggf5d6

Frankenhuis, W. E., Young, E. S., & Ellis, B. J. (2020). The hidden talents approach: Theoretical and methodological challenges. *Trends in Cognitive Sciences*, *24*(7), 569–581. https://doi.org/10.1016/j.tics.2020.03.007

Hackman, D. A., Betancourt, L. M., Gallop, R., Romer, D., Brodsky, N. L., Hurt, H., & Farah, M. J. (2014). Mapping the Trajectory of Socioeconomic Disparity in Working Memory: Parental and Neighborhood Factors. *Child Development*, *85*(4), 1433–1445. https://doi.org/10/f6fp5j

Hackman, D. A., Farah, M. J., & Meaney, M. J. (2010). Socioeconomic status and the brain: Mechanistic insights from human and animal research. *Nature Reviews Neuroscience*, *11*(9), 651–659. https://doi.org/10/b254c6

McLaughlin, K. A., Weissman, D., & Bitrán, D. (2019). Childhood adversity and neural development: A systematic review. *Annual Review of Developmental Psychology*, *1*(1), 277–312. https://doi.org/10/gj59n7

Mittal, C., Griskevicius, V., Simpson, J. A., Sung, S., & Young, E. S. (2015). Cognitive adaptations to stressful environments: When childhood adversity enhances adult executive function. *Journal of Personality and Social Psychology*, *109*(4), 604–621. https://doi.org/10.1037/pspi0000028

Muskens. (2019). *Hidden obstacles in education for students from low socioeconomic backgrounds:* [maastricht university]. https://doi.org/10.26481/dis.20191115mm

NICHD Early Child Care Research Network. (2005). *Child care and child development: Results from the NICHD study of early child care and youth development* (pp. xx, 474). The Guilford Press.

Nweze, T., Nwoke, M. B., Nwufo, J. I., Aniekwu, R. I., & Lange, F. (2021). Working for the future: Parentally deprived Nigerian children have enhanced working memory ability. *Journal of Child Psychology and Psychiatry, and Allied Disciplines*, *62*(3), 280–288. https://doi.org/10/gphn59

Raby, K. L., Roisman, G. I., Fraley, R. C., & Simpson, J. A. (2015). The enduring predictive significance of early maternal sensitivity: Social and academic competence through age 32 years. *Child Development*, *86*(3), 695–708. https://doi.org/10/gjh5cc

Rozin, P. (2001). Social Psychology and Science: Some Lessons From Solomon Asch. *Personality and Social Psychology Review*, *5*(1), 2–14. https://doi.org/10/bhqn85

Scheel, A. M., Tiokhin, L., Isager, P. M., & Lakens, D. (2021). Why Hypothesis Testers Should Spend Less Time Testing Hypotheses. *Perspectives on Psychological Science*, *16*(4), 744–755. https://doi.org/10/ghp4k7

Ursache, A., & Noble, K. G. (2016). Neurocognitive development in socioeconomic context: Multiple mechanisms and implications for measuring socioeconomic status. *Psychophysiology*, *53*(1), 71–82. https://doi.org/10/f8jcxn

Woodcock, R. W. (1990). Theoretical Foundations of the Wj-R Measures of Cognitive Ability. *Journal of Psychoeducational Assessment*, *8*(3), 231–258. https://doi.org/10/ft7mjn

Woodcock, R. W., Johnson, M. B., & Mather, N. (1990). *Woodcock-Johnson psycho-educational battery—Revised*. DLM Teaching Resources.

Young, E. S., Frankenhuis, W. E., DelPriore, D. J., & Ellis, B. J. (2022). Hidden talents in context: Cognitive performance with abstract versus ecological stimuli among adversity-exposed youth. *Child Development*, *93*(5), 1493–1510. https://doi.org/10.1111/cdev.13766

Young, E. S., Griskevicius, V., Simpson, J. A., Waters, T. E. A., & Mittal, C. (2018). Can an unpredictable childhood environment enhance working memory? Testing the sensitized-specialization hypothesis. *Journal of Personality and Social Psychology*, *114*(6), 891–908. https://doi.org/10.1037/pspi0000124