Trends in Cognitive Sciences

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Review

The Hidden Talents Approach: Theoretical and Methodological Challenges

Willem E. Frankenhuis,[1,*] Ethan S. Young,[1] and Bruce J. Ellis[2]

It is well established that people living in adverse conditions tend to score lower on a variety of social and cognitive tests. However, recent research shows that people may also develop 'hidden talents', that is, mental abilities that are enhanced through adversity. The hidden talents program sets out to document these abilities, their development, and their manifestations in different contexts. Although this approach has led to new insights and findings, it also comes with theoretical and methodological challenges. Here, we discuss six of these challenges. We conclude that the hidden talents approach is promising, but there is much scope for refining ideas and testing assumptions. We discuss our goal to advance this research program with integrity despite the current incentives in science.

Introduction to the Hidden Talents Approach

It is well known that people living in adverse conditions, such as poverty, tend to score lower on a variety of cognitive tests [1,2]. These findings have led to the deficit model, which holds that chronic stress impairs brain structure and function in ways that undermine mental abilities. Policies and interventions based on the deficit model have had mixed success, but have generally improved the lives of many people. However, we have argued that the deficit model is incomplete, in that it lacks a focus on the ways in which adaptive developmental processes shape social and cognitive abilities in contexts of adversity. Therefore to complement the prevailing deficit model, we propose the 'hidden talents' approach [3,4].

The hidden talents approach focuses on mental abilities that are enhanced through adversity [3,4]. The scientific goal of the approach is to map these abilities, their development, and their manifestations in different contexts. The applied goal is to leverage knowledge about hidden talents in education and the workplace. The hidden talents approach should not be viewed as an alternative to the deficit model, but as an ally. Together, these perspectives offer a more well-rounded view (Figure 1). However, this view does not imply that adaptation and impairment have equal weights in shaping abilities. Even when impairment reduces an ability more than adaptation improves it, a complete understanding includes both processes.

The hidden talents approach acknowledges that poverty and adversity are harmful. It is undesirable for people to grow up in either poverty or adversity or both. The research program does not defend the status quo: we need to eradicate poverty and, where it exists, make every effort to reduce social and structural barriers for people living in poverty [5]. We also recognize that poverty is not synonymous with stress, and that poverty and adversity have separable effects on cognition [6,7]. People living in poverty have many diverse experiences, even if they are more often exposed to stressful events [1,8,9]. Although our focus is not on impairment, it should be clear that we value approaches that seek to understand, prevent, and repair deficits that result from adverse conditions.

Highlights

The hidden talents approach investigates social and cognitive abilities that are enhanced through adversity; this approach has led to new findings; however, it also comes with theoretical and methodological challenges.

Hidden talents may include the ability to detect and memorize threats, find creative solutions, understand other people, and deal with changing environments.

To date, some results support the hidden talents approach, others contradict it, and still others provide mixed evidence; thus, there is much scope for future research to advance knowledge.

Formal theory and empirical studies should explore how specific forms of adversity shape mental abilities in different ways, and how impairment and adaptation interact.

The study of cognitive development in adverse conditions is moving towards a well-rounded view that includes impairments, compensatory strategies, and enhanced abilities.

[1]Behavioural Science Institute, Radboud University, Montessorilaan 3, PO Box 9104, 6500, HE, Nijmegen, The Netherlands
[2]Departments of Psychology and Anthropology, University of Utah, 380 South 1530 East BEHS 502, Salt Lake City, UT 84112, USA

*Correspondence: wfrankenhuis@gmail.com (W.E. Frankenhuis).

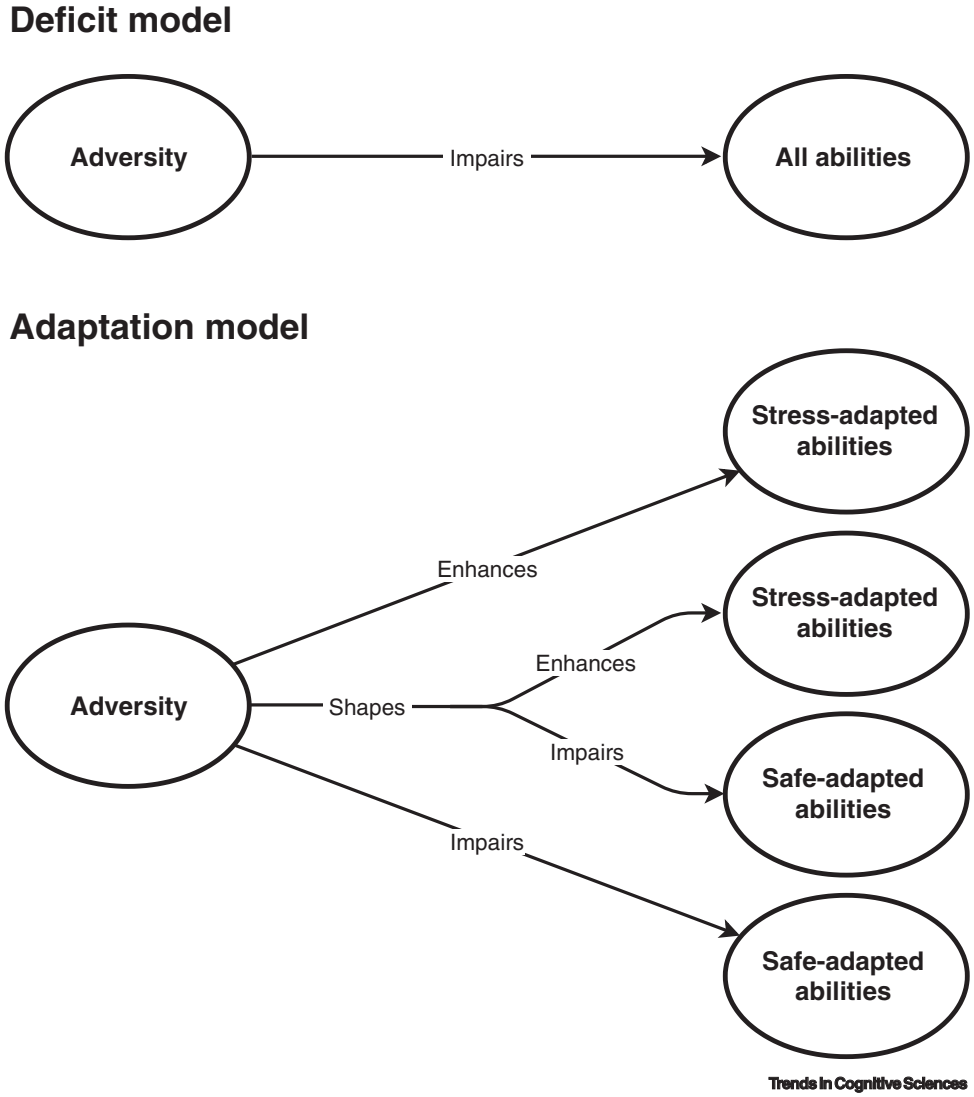

Figure 1. Comparing the Deficit Model with the Adaptation Model**.** The deficit model focuses on the ways in which adversity impairs the mind. By contrast, the adaptation model assumes that abilities are also shaped by adverse experiences in ways that improve the adaptive fit between individuals and their environments. Exposures to adversity may enhance abilities that are useful in stressful conditions, but impair abilities that are not as useful. Adversity may also shape abilities in different directions; for instance, enhance one ability while impairing another, especially if these abilities trade off with each other. The adaptation model is mutually compatible with the deficit model and suggests new directions for future research. For example, adversity might enhance sets of related but distinct abilities (e.g., attention shifting, working memory updating, vigilance, etc.) and impair others, within the same person. Thus, future research could examine the extent to which there are sets of correlated hidden talents and corresponding sets of impairments.

Assumptions of the Hidden Talents Approach

The hidden talents approach contributes a unique focus on social and cognitive abilities that are enhanced by adversity, as quantified by objective benchmarks, such as speed or accuracy [3,4]. Existing theories of adaptive development in adverse conditions have focused on physiological, dispositional, and behavioral responses (e.g., accelerated reproductive development, insecure attachment style, or steep future discounting), but not on criterion-referenced skills. The hidden

talents approach complements this body of work by integrating findings and generating hypotheses about the mental abilities that are enhanced through adversity.

Four assumptions guide the hidden talents program. First, adaptive developmental processes improve the fit between individuals and their environments. This is true whether the environment is safe and supportive or harsh and unpredictable. Second, because different dimensions of adversity pose unique challenges, specific forms of adversity (e.g., abuse versus neglect) may shape mental abilities in different ways [9–12]. Hence, our method is to measure exposures to specific dimensions of stress, rather than cumulative adversity, and link them to specific abilities thought to be useful under those conditions. Third, the approach assumes that people perform best when tested in contexts and with materials that match their lived experiences. As such, we strive to make test materials relevant for people living in adverse conditions and to create test settings that do not evoke test anxiety (e.g., working with a diverse staff to conduct research in the community). Fourth, the approach assumes that some skills that enable people to function in harsh, unpredictable environments can be leveraged to promote success in mainstream contexts, such as schools and workplaces. These assumptions form the core of the research program.

Here, we emphasize theoretical and methodological challenges for the hidden talents program, and illustrate these using empirical examples. Our goal is to inform readers about the promise and pitfalls of this program. Too often, the current incentives in science reward people and programs that overstate theoretical and empirical support (Box 1). This practice distorts the scientific record and leads researchers down blind alleys. Therefore, we also highlight limitations and gaps in the hidden talents program, while also showcasing its strengths.

Challenge 1: Measuring Adaptive Outcomes

Adaptation refers to the fit between organisms and their environments. However, the specific criteria used to evaluate 'adaptive fit' differ between disciplines. In clinical and developmental

Box 1. Advancing a New Research Program with Integrity

The hidden talents approach is appealing: we all want better outcomes for people who suffer. This appeal is not only attractive, but also dangerous. It tempts producers and consumers of information to be less critical of ideas and evidence. This problem is exacerbated by the current incentives in science, which favor polished narratives presented with data that appear to support the hypotheses [81,82]. However, the times are changing. Over the past decade, there have been significant efforts to make research more transparent [83,84]. We support these efforts. Transparency does not guarantee quality, but it does create access to the information needed to evaluate quality [85]. Meta-scientist Simine Vazire insightfully noted that transparency ensures research gets the credibility it deserves [86][iv].

Transparent research is likely to result in mixed findings, even when there is a true effect [87–89]. To estimate effect sizes accurately, it is best to have a complete scientific record. Towards this end, researchers may consider writing up data sets that are currently in a file-drawer, for instance, because they did not show the expected association between adversity and a measure of cognitive outcomes. There is also scope for conducting secondary data analyses that involve a variety of statistical techniques, alongside null hypothesis testing, to make null results maximally informative [90]. Researchers might use Bayes analyses (e.g., Bayes Factors), for instance, to explore whether the observed data is more likely to be generated by the null hypothesis than by alternative hypotheses, and by how much [91]. Null results can also provide insight into intact abilities and compensatory strategies. For instance, Markant *et al.* [92] showed that infants from low socioeconomic conditions showed worse memory performance in a spatial cueing task if they encoded objects with basic orienting processes; however, their performance showed no difference if they used selective attention during encoding.

It is important for a balanced pattern to see the light of day, because the prevailing frameworks set priors for the plausibility of new findings. Frankenhuis and Nettle [93] argued that: 'a theoretical framework that acknowledges strengths can counteract publication bias. Without this framework, scholars are more likely to interpret nondeficit results (i.e., intact or enhanced performance) as a fluke, and journals might hesitate to publish such results, when actually the data offer genuine insight. With this framework, scholars who unexpectedly find nondeficit results can explicitly state this violation of their predictions and then consider whether performance reflects adaptation to context' ([93], p. 16) (for instance, see [94] for a report of an unexpected positive association between more paternal transitions and improved effortful control).

psychology, criteria include values such as health and well-being. In biology, adaptation refers to the fitness of a strategy, typically measured by the long-term growth rate of a lineage [13]. This growth rate can often not be observed. Therefore, researchers use proxies, such as survival and reproductive success (e.g., [14]); or their correlates, such as access to mates and social status (e.g., [15]). We use the term 'adaptation' in this biological sense. Thus, if a person living in hostile conditions develops vigilance for protection or antisocial behavior to gain social status or access to mates, these responses may be adaptive, even when they imply costs to health and well-being [8,16,17].

However, studies of hidden talents have not measured adaptive outcomes. They have quantified performance on tasks. For instance, children who have been physically abused are able to detect threats (e.g., angry facial expression) faster and more accurately than children who have not been abused [18–20]. The original authors of this work did not speculate about adaptive value, but we have argued that these abilities are adaptive [3,4]. We have made the same argument for findings showing that individuals who have been physically and/or sexually abused may develop enhanced abilities for memorizing threats relevant to their trauma [21,22], as well as for findings showing that insecurely attached 3-year-old boys were better able to recall negative events but worse at recalling positive events than were securely attached boys [23]. However, our assumption has yet to be tested. To our knowledge, no studies have yet demonstrated a link between hidden talents and adaptive outcomes. We would like to add that, in our own preliminary study, we unexpectedly found that people from a community sample exposed to more violence were both slower and less accurate at detecting threat ([24], although see [25], which reported faster task performance in children living near a location where recent violent crime had occurred).

Future research could examine whether people achieve real-world benefits from their hidden talents. For example, are people who are skilled at detecting and memorizing threats in a dangerous neighborhood less likely to be attacked or get hurt? One may counter that hidden talents offer benefits without currently increasing fitness. A person might accrue resources, but not survival or reproductive benefits, in contemporary environments, even though accruing resources increased fitness over evolutionary time. We agree. Alternatively, one may counter that developing hidden talents is without any benefit in contemporary societies. This position makes testing the putative benefits of hidden talents difficult. Therefore, we prefer to assume that hidden talents on average benefit people in their contexts, either directly in terms of survival and reproduction, or indirectly in terms of the perquisites of fitness, such as social status and resource acquisition.

The challenge of linking behaviors to adaptive outcomes is, of course, not unique to the hidden talents approach. It also applies to other approaches that focus on biological adaptation (e.g., evolutionary psychology or behavioral ecology). Future research on hidden talents may look to methods used by these approaches for measuring adaptive outcomes.

Challenge 2: Mapping Dimensions of Adversity to Cognitive Abilities

It is often not straightforward which traits are adaptive in which conditions. For instance, research shows that people living in poverty, who are more often exposed to adversity (including social subordination), may show greater attunement to other people and to social relationships. They might be more accurate at inferring the emotional states of other people and show greater compassion [26], and also be better able to understand change and uncertainty in social relationships [27]. Also, anxiously attached people may be good at detecting deception [28,29], and previously institutionalized, adopted youth may be better at making decisions about which people to trust than their never-institutionalized, nonadopted peers [30].

In our own work, we have found mixed evidence for enhanced social-cognitive abilities. For instance, college students exposed to more adversity were better at detecting deception on only one of several measures, and this finding did not replicate in a more socioeconomically diverse community sample [31]. A different study of the same community sample found that people with more violence exposure in their current environment were equally good, or even better, at memorizing social-dominance relationships. However, for these individuals, childhood exposure to violence predicted the opposite: impaired memory for social-dominance relationships [32]. Although the studies described in this section have not reported sex differences, exploring such differences may be a fruitful direction for future research [33,34]. For instance, skills underlying 'fight or flight' may be more relevant for males and 'tend and befriend' for females [35].

It is possible that, for socially subordinated people, enhanced empathic accuracy may promote behavioral prediction and management of external social forces, including people that influence their life outcomes [36]. However, how do we know that this ability is not equally beneficial among high-status individuals? Moreover, there are also costs to investing time and energy in understanding other people, and these costs may be greater for people who have less 'mental bandwidth' or reserve capacity due to pressing immediate needs [37]. Thus, knowing what traits are adaptive in which conditions is not trivial. It often requires a cost–benefit analysis that involves multiple factors and processes. Evolutionary biologists solve this challenge by building formal models that explore the conditions in which different cognitive or behavioral strategies are adaptive [38]. The hidden talents approach could also benefit from such modeling.

Consider the effects of harshness and unpredictability on cognitive development and behavior. Harshness can be defined as age-specific rates of disability and death, and unpredictability as random variation in harshness over space or time [39]. Both harsh and unpredictability are stressful, but should they favor the same responses? On the one hand, both may favor high levels of vigilance; to prepare for danger versus to anticipate potential changes in the environment. On the other, they may enhance different abilities because they pose different challenges, which require different abilities to solve. Formal modeling helps to clarify which responses are adaptive depending on the specific parameters of the environment [38,40]. For the study of hidden talents, relevant parameters may include how harshness affects different age groups and whether unpredictability occurs over short timescales (e.g., escalation of conflict over seconds) or long timescales (e.g., changing levels of neighborhood violence over months or years).

Challenge 3: Teasing Apart the Effects of Developmental and Current Conditions

Even if we know which abilities are adaptive in particular conditions, an open question is: do the types of hidden talents that develop, and when these abilities develop, depend on the timing of adversity exposures? Which abilities are enhanced by early-life conditions, which ones by a combination of early-life and current conditions, and which ones by current conditions (Figure 2)? There is currently no well-developed theory for addressing these questions. However, there are some initial empirical findings.

Research suggests that people who have experienced unpredictable childhood conditions develop enhanced abilities for shifting attention ([41,42], but see [43]) and for updating working memory ([44], see also [43]). In some studies, these abilities manifest irrespective of the current conditions; in others, they manifest only under psychological stress, induced through experimental manipulation of uncertainty. Related sensitization effects have been reported in nonhuman animals. For instance, only when tested under demanding conditions (characterized by the elevated glucocorticoid levels typical of an active stress response), rat pups of low-caring mothers (high

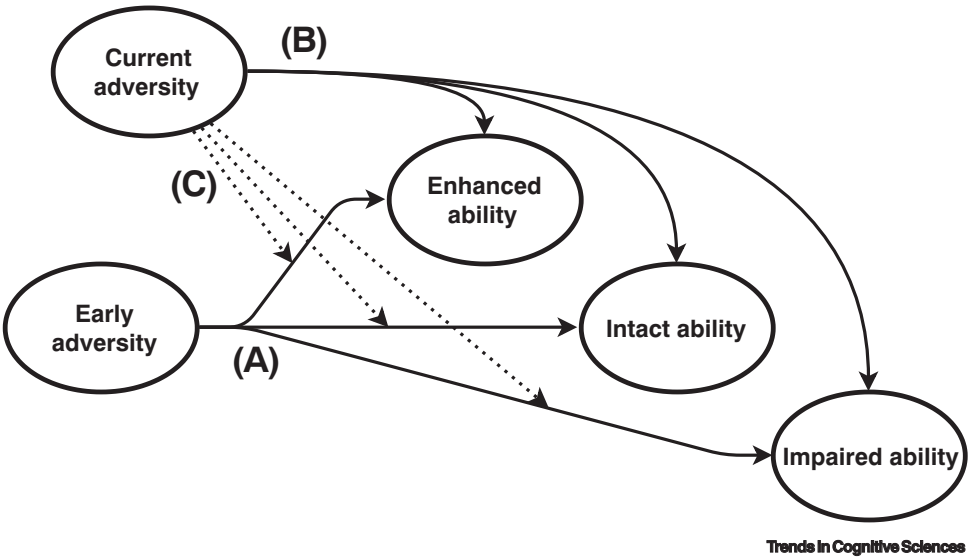

Figure 2. How Exposure to Adversity Might Shape a Specific Ability. There are at least three distinct ways of thinking about how adversity shapes the development of abilities. (A) Early adversity shapes the development of abilities, resulting in enhanced, intact, or impaired performance; (B) current adversity exposure affects abilities, irrespective of developmental exposures; or (C) the interaction between early and current adversity affects performance.

developmental stress) outperform pups of high-caring mothers (low developmental stress) on tasks requiring learning and memory of currently fearful contexts [45,46] and learning to associate neutral stimuli with frightening stimuli [47]. Under basal (nondemanding) conditions, pups of high-caring mothers performed better on the same tests.

Overall, some studies report effects of early conditions, others interactive effects of early and current conditions, and still others effects of current conditions. The hidden talents approach currently lacks theory to predict which of these responses to expect in any given case. Progress could come, again, from building formal models that explore the benefits and costs of each of these responses in different environmental conditions and for different mental abilities [40]. It could also come from better integration of knowledge from related disciplines, such as neuroscience. For instance, research shows that acute stress influences distinct memory systems in different ways. Specifically, acute stress causes a shift from top-down explicit (hippocampal-prefrontal dependent) memory systems to bottom-up procedural (striatum-dependent) systems [48–50]. Consideration of this process may inform, for instance, new predictions about the roles of early and current conditions in producing the finding that people in poverty display similar [48] or enhanced [51] performance on some procedural memory tasks, compared with people in affluence.

Generally, there is scope for more synergy with developmental neuroscience (see [52] for a thoughtful discussion). This field is accumulating knowledge about the neurobiological consequences of exposures to different dimensions of adversity, which can provide an avenue for generating hypotheses about the ways in which different dimensions of adversity may enhance mental abilities, alongside potential impairments that these exposures may cause. For instance, research shows that neglect (omission) and physical abuse (commission) may lead to different kinds of cognitive and physiological impairments [9–12]. Future research may explore whether these adverse exposures also lead to different cognitive enhancements (although see [53]).

Challenge 4: Predictions When Adaptation and Impairment Operate in Concert

Let us assume we are designing the perfect study: based on formal modeling and knowledge from other fields, we have developed a clear hypothesis about which specific dimensions of the environment enhance particular cognitive abilities. The question arises: what does this hypothesis predict about variation in performance both within and between individuals? Consider the hypothesis that violence exposure enhances people's ability to detect danger. If adaptation were the only process, a between-person comparison would be suitable: we would expect people who had more exposure to violence to be better at detecting threats than people who had less exposure to violence. However, adaptation may not be the only process. Exposure to violence may cause impairment, for instance, through the effects of toxic stress (e.g., allostatic load) or via the direct impact of physical trauma to the brain. If impairment and adaptation processes operate in parallel, people whose cognition has been enhanced by adversity may not outperform people whose cognition has not been enhanced by adversity (Figure 3 and Box 2).

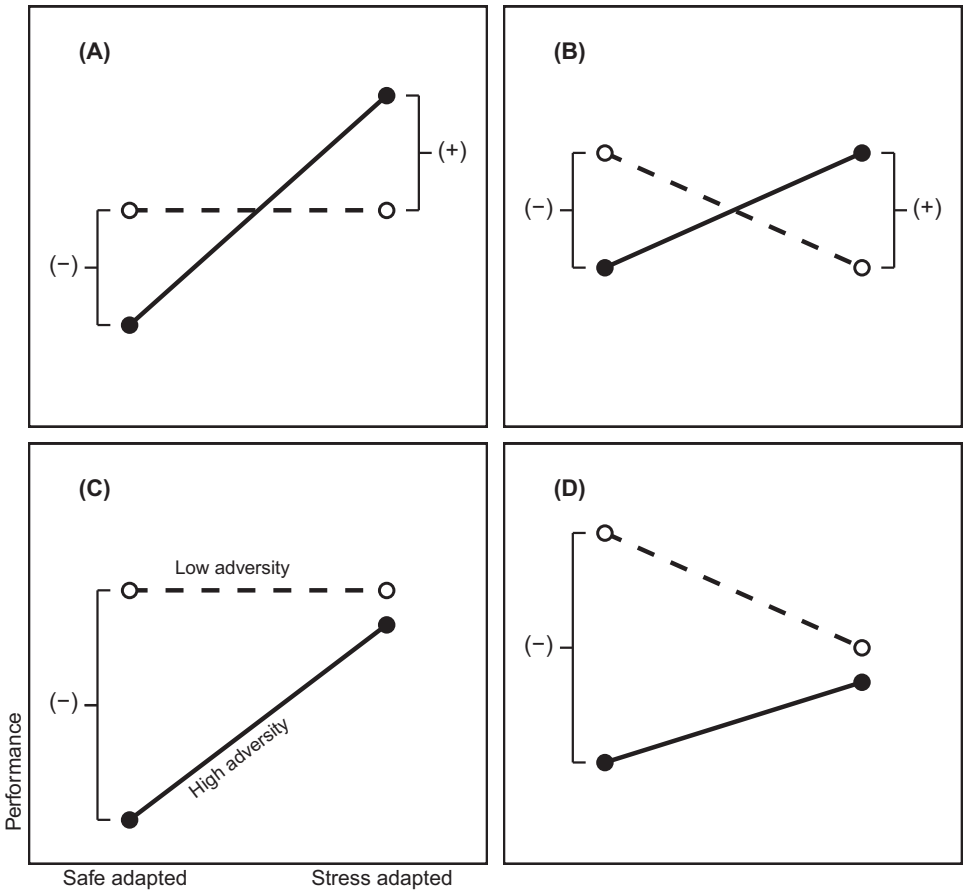

Figure 3. Detecting Hidden Talents in Data. The hidden talents program focuses on abilities that are enhanced through adversity. If an ability is enhanced, people exposed to adversity may perform better on a task measuring this ability compared with people who have not had such exposures. However, this is not always the case. It depends on how impairment and adaptation processes jointly affect performance. Four potential interaction patterns are depicted in (A–D). (A) and (B) show that people who have been exposed to adversity perform better on stress-adapted abilities, both within and across individuals. By contrast, (C) and (D) depict a within-person effect, only. In this scenario, had we only measured stress-adapted abilities, without comparing them with safe-adapted abilities, we would have concluded impairment only and missed signatures of adaptation that emerge in the within-person comparison. For a complete picture, we need to compare not only performance across individuals, but also different abilities within the same person.

Box 2. Determining Statistical Criteria Consistent with Hidden Talent Effects

The hidden talents approach appears to make a straightforward prediction: more exposure to adversity should lead to enhanced stress-adapted abilities. To test this, we could examine how adversity relates to a (putative) stress-adapted ability. If we find a positive correlation, the evidence suggests a hidden talent. If we find a negative or no correlation, the ability is either impaired or unaffected by adversity. However, this design has a key limitation: it can only reveal a hidden talent when people from adverse backgrounds outperform people from safe backgrounds.

Adversity exposures might rarely lead to outperformance, especially if there are parallel adaptation and impairment processes operating on the same ability. Instead, hidden talents may emerge within a person relative to other abilities or under particular conditions. For example, some studies have compared a single ability (e.g., memory) across different task conditions (e.g., concrete versus abstract stimuli) or in different contexts (e.g., safety versus threat). The idea is that people from stressful environments benefit more from particular types of content or context than people from nonstressful environments. Other studies have compared two abilities (e.g., inhibition versus attention shifting) in different conditions or contexts. Here, one ability may be impaired (e.g., inhibition) and another enhanced (e.g., attention shifting), where this enhancement might only manifest in the more ecologically valid condition.

The key point is that whether we observe a hidden talent depends on how we compare performance. Suppose we test two individuals, Anne and Sue. Anne is from an adverse environment and Sue is from a safe background. They complete a math and a danger detection task. If we compare their performance, what should we expect? Anne's danger detection performance could be consistent with a hidden talent in three ways: (i) Anne could outperform Sue; (ii) Anne could perform better at danger detection relative to her math performance; or (iii) both. Scenarios (i) and (iii) imply some form of cross-over (disordinal) interaction between the type of ability being measured and adversity exposure. However, Scenario (ii) can occur even if Sue's performance is objectively higher on both tasks (e.g., ordinal interaction). If we had only measured a stress-adapted skill (e.g., danger detection but not math), we would have missed the opportunity to detect a hidden talent in the context of an ordinal interaction (see Figure 3 in the main text). This means we need to think carefully about how to design our studies to be able to detect hidden talents.

In some cases, a viable solution might be to control for indicators of impairment (e.g., psychopathology), but this strategy has caveats (Box 3). First, such covariates might control for certain kinds of impairment but not others. Second, due to task impurity (i.e., performance on any task depends on multiple cognitive processes), we might inadvertently factor out variance on the hidden talents task that results from stress-adapted abilities. Third, there may be true overlap between stress-adapted abilities and trauma, including associated psychopathology.

An empirical example can illustrate this. In one study, people who had been exposed to trauma, independent of whether they additionally developed post-traumatic stress disorder (PTSD), showed more flexibility in implementing cognitive control and, thus, higher adaptability to their immediate environment compared with people who had not been exposed ([54], see also [55]). This relation was dose dependent, with more frequent exposures to more severe trauma being associated with more flexible cognitive control. It is possible, although it has not been empirically demonstrated, that other (anxiety- or mood-related) psychopathologies mediate this effect. If those psychopathologies are more common among people exposed to more severe trauma, then controlling for PTSD (which is also more common among more highly traumatized individuals), or excluding individuals with PTSD from the sample, would reduce the scope for detecting enhanced cognitive control abilities. Thus, there may be costs to controlling for psychopathology. Despite these caveats, controlling for impairment may be appropriate in some cases.

Challenge 5: Study Designs That Allow Hidden Talents to Manifest

Some studies of hidden talents have used within-person designs. These studies have compared a single ability (e.g., memory) in different conditions (e.g., concrete versus abstract stimuli) or in different contexts (e.g., settings that vary in the extent to which they minimize the reality of daily stressors and uncertainties). The expectation is that people from stressful environments benefit more from particular types of content or context than people from nonstressful environments. Other studies have compared two abilities (e.g., inhibition versus attention shifting) in different

Box 3. Conceptually Distinct but Empirically Correlated Dimensions of Adversity

A guiding assumption of the hidden talents research program is that stress-adapted abilities enable one to function (survive, obtain resources, and navigate significant challenges) within the constraints imposed by harsh, unpredictable environments. Thus, pursing research on hidden talents involves measuring exposures to harsh and/or unpredictable environments, as well as obtaining samples that represent meaningful variation in such environments. Accomplishing these tasks involves two particular challenges related to the co-occurrence of adversity exposures.

The first involves distinguishing between different adversity exposures. The hidden talents approach focuses on specific dimensions of stress, rather than on general indices of adversity (such as cumulative risk scores), and attempts to link these dimensions to relevant stress-adapted abilities. However, testing for effects of specific dimensions of childhood stress is challenging because different types of adversity tend to co-occur. Although it would be valuable to study individuals who have only experienced one kind of adversity in isolation (e.g., violence exposure with minimal unpredictability), it is not feasible to recruit such specialized samples. Therefore, research on hidden talents inevitably tests for effects of specific dimensions of stress despite their co-occurrence with other dimensions. Addressing this issue may involve controlling for co-occurring stress exposures, to determine whether specific experiences uniquely shape specific stress-adapted abilities. In some cases, the causality of specific stress exposures could be examined in experimental research with nonhuman animals (as in research with bonnet macaques that clearly distinguished between harsh versus unpredictable foraging conditions [95]).

The second challenge involves identifying appropriate samples for testing hidden talents. A central assumption of the hidden talents perspective is that adversity exposures lead to the development of stress-adapted abilities. However, normative experiences of adversity may co-occur with other experiences and with conditions that can impair, rather than shape, mental abilities (e.g., developmental disabilities, histories of head trauma, or substance abuse). Such background experiences and conditions could counteract any social or cognitive enhancements resulting from normative exposures to harsh or unpredictable conditions. Careful research methods are needed to study developmental adaptations to stress separate from impairments resulting from undue environmental insults, lifestyle choices, or other harmful dysfunctions. This may necessitate excluding individuals with such impairments and/or recruiting samples that minimize their occurrence (e.g., preadolescent samples who do not yet have extensive substance exposure). However, in some instances, this strategy could result in a biased sample, because people who have lower levels of mental functioning might be more likely to incur such impairments, even before these impairments negatively affect mental abilities.

conditions or contexts. The expectation here is that one ability may be impaired in stress-exposed people (e.g., inhibition), and the other ability enhanced (e.g., attention shifting), where this enhancement might only manifest in the more ecologically valid condition.

As with between-person designs, it is challenging to make predictions about the interaction shape when adaptation and impairment processes interact (Figure 3 and Box 2). We expect the slope to be steeper for stress-adapted individuals between conditions or contexts. However, it is not clear whether we expect ordinal or disordinal (cross-over) interaction. This ambiguity is not problematic, if acknowledged. Alternatively, we may predict a particular interaction shape if we have good grounds for assigning a priori weights to adaptation and impairment. If a chronic stressor produces only adaptation, we might expect disordinal interaction. If it also produces impairment, we expect ordinal interaction. In such cases, a practical challenge is to obtain sample sizes large enough to conduct well-powered statistical analyses of different interaction shapes.

As noted earlier, the hidden talents approach assumes that people perform best in test settings and using stimuli that match the way they are using their abilities in the real world. This assumption was inspired by research from cultural psychology showing, for instance, that economically disadvantaged Brazilian children could solve mathematical problems, quickly and accurately, on the market (where they sell goods to make a living), but less well in a classroom setting [56]. This result was recently replicated with working children in India (A.V. Banerjee *et al*., unpublished data, 2017)[i]. Schliemann and Carraher [56] note about their participants: 'Their failure in school arithmetic arises not through cognitive deficits, but rather from troubles in adopting written symbolic systems and procedures' ([56], pp. 250–251). Children with fewer resources may use alternative strategies to solve mathematical problems. For instance, they

may use successive addition instead of multiplication [57], and may benefit more from relying on pictures rather than words [58]. Children living on the streets in South Africa [59] and Bolivia [60] may also show enhancements in aspects of creativity, such as the ability to generate alternative solutions to problems, compared with children not living on the streets ([61], but see [62]).

Ecological validity has myriad dimensions: stimulus content, stimulus format, response format, test setting, psychological state, incentives, and so on. To date, most studies have varied several of these dimensions simultaneously and demonstrated enhanced performance in more ecologically valid settings [63]. Future research needs to examine the separate contributions of each dimension as well as interactions between dimensions. Generally, the field needs more research that determines the contexts that optimize the performance of stress-adapted individuals [3,4,64,65]. As Barbara Rogoff and colleagues noted: 'A challenge for future research is looking for strengths in all populations and designing learning situations and assessments in ways that build on and build toward the strengths of all' ([66], p. 885).

We should also consider the possibility that ecological validity does not always improve performance. In a recent well-powered and preregistered analysis of an existing data set [national standardized tests administered in schools across 58 countries (total N = 5 501 165)], students from low socioeconomic backgrounds performed substantially 'worse' on items that were more ecologically valid (e.g., about money) than on items that were less ecologically valid (e.g., purely numerical) (M.M.E. Muskens, PhD thesis, Maastricht University, 2019)[ii]. Moreover, another study recently obtained the same result in three data sets[iii]. There is experimental research underway that can provide insight into this surprising finding.

Challenge 6: Ranking Performance on Tasks Measuring Hidden Talents

Which criteria should be used to determine whether people show enhanced performance on a cognitive task? Research on hidden talents has emphasized the need to use objective benchmarks for performance, such as speed or accuracy [3,4]. If two people provide the same responses on a task, but one solved this task faster or more accurately, that person has an edge. However, other examples are less clear-cut. For instance, response bias (e.g., erring on the side of caution) may lead to higher payoffs when the costs of one error (e.g., failing to detect a real threat) exceed those of another (e.g., perceiving a threat that is not actually there) [67–70]. Indeed, response bias is commonly reported in studies showing that people with more exposure to violence are more likely to attribute hostile intent to friendly or ambiguous vignettes, pictures, or videos [71–73].

If response bias leads to a higher payoff, should we refer to this bias as a hidden talent? We are still wrestling with this question, but our tentative answer is 'no'. Consider an extreme case: a person who always perceives danger, irrespective of whether danger is present, maximizes payoffs (due to asymmetric costs of errors). This person's cognition is functional, but in our view not skilled. We prefer to reserve the term 'hidden talents' for abilities that lead to enhanced accuracy, speed, and so on. However, our definition is not without problems. For instance, there may be cases where stress exposures enhance accuracy or speed at a cost to payoffs. If we call this a 'hidden talent', even though this response is less functional than response bias, there is friction with our assumption that hidden talents are produced by adaptive developmental mechanisms. Future theoretical work should address this issue. Regardless of definitions, hidden talents research should start using formal optimality modeling to compute optimal levels of bias and accuracy. Such models may be built, for instance, using the framework of signal detection theory with sequential decisions [74], combined with Bayesian updating [75].

Concluding Remarks

The hidden talents program is a new approach that focuses on social and cognitive abilities that are enhanced by adversity. This approach complements the existing models of development under stress, which have focused primarily on deficits. To date, some results support the hidden talents approach, others contradict it, and still others provide mixed evidence. This pattern of results is noteworthy in relation to the broader literature, which has nearly exclusively reported deficits in people living in adverse conditions. There is much scope for future research to advance knowledge (see Outstanding Questions).

The hidden talents approach is building connections with other strength-based approaches (B.J. Ellis *et al.*, unpublished data, 2020), such as resilience research, which focuses on the protective factors that enable people who live in adverse conditions to make the most of their challenging life circumstances [76,77]; positive youth development and social justice approaches that develop policy and interventions that harness strengths alongside addressing vulnerabilities [78,79]; and the successful intelligence approach, which seeks to document the abilities that people need to achieve their life goals within a specific cultural context [63]. We expect connections between strength-based approaches to grow in the coming years, as well as their connections with deficit approaches. Together, these perspectives are well equipped to develop strong ties with the other biological and social sciences, advancing consilience, the integration of all sciences [80].

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Resources

[i]https://static1.squarespace.com/static/5990cfd52994ca797742fae9/t/59a896aee6f2e11b76983238/1504220847338/Banerjee+et+al.+2017+-+2017-08-17.pdf

[ii]https://cris.maastrichtuniversity.nl/ws/portalfiles/portal/38342455/c6533.pdf

[iii]https://drive.google.com/file/d/1dvB266Xkkb-ZdliLq6WqttJVpAycQvTz/view

[iv]www.psychologicalscience.org/observer/do-we-want-to-be-credible-or-incredible

References

1. Duncan, G.J. *et al.* (2017) Moving beyond correlations in assessing the consequences of poverty. *Annu. Rev. Psychol.* 68, 413–434
2. Ursache, A. and Noble, K.G. (2016) Neurocognitive development in socioeconomic context: multiple mechanisms and implications for measuring socioeconomic status. *Psychophysiology* 53, 71–82
3. Ellis, B.J. *et al.* (2017) Beyond risk and protective factors: an adaptation-based approach to resilience. *Perspect. Psychol. Sci.* 12, 561–587
4. Frankenhuis, W.E. and de Weerth, C. (2013) Does early-life exposure to stress shape or impair cognition? *Curr. Dir. Psychol. Sci.* 22, 407–412
5. Raver, C.C. and Blair, C. (2020) Developmental science aimed at reducing inequality: maximizing the social impact of research on executive function in context. *Infant Child Dev.* 29, e2175
6. Amso, D. and Lynn, A. (2017) Distinctive mechanisms of adversity and socioeconomic inequality in child development: a review and recommendations for evidence-based policy. *Policy Insights Behav. Brain Sci.* 4, 139–146
7. Farah, M.J. (2018) Socioeconomic status and the brain: prospects for neuroscience-informed policy. *Nat. Rev. Neurosci.* 19, 428–438
8. Blair, C. and Raver, C.C. (2012) Child development in the context of adversity: experiential canalization of brain and behavior. *Am. Psychol.* 67, 309–318
9. McLaughlin, K.A. *et al.* (2019) Childhood adversity and neural development: a systematic review. *Annu. Rev. Dev. Psych.* 1, 277–312
10. Humphreys, K.L. and Zeanah, C.H. (2015) Deviations from the expectable environment in early childhood and emerging psychopathology. *Neuropsychopharmacology* 40, 154–170
11. Sheridan, M.A. and McLaughlin, K.A. (2014) Dimensions of early experience and neural development: deprivation and threat. *Trends Cogn. Sci.* 18, 580–585
12. Sumner, J.A. *et al.* (2019) Early experiences of threat, but not deprivation, are associated with accelerated biological aging in children and adolescents. *Biol. Psychiat.* 85, 268–278
13. Frankenhuis, W.E. and Del Giudice, M. (2012) When do adaptive developmental mechanisms yield maladaptive outcomes? *Dev. Psychol.* 48, 628–642
14. Yao, S. *et al.* (2014) Criminal offending as part of an alternative reproductive strategy: investigating evolutionary hypotheses using Swedish total population data. *Evol. Hum. Behav.* 35, 481–488

Outstanding Questions

What attention, learning, memory, reasoning, problem-solving, and decision-making abilities are enhanced by exposure to adversity?

How do we tease apart the effects of conceptually distinct but empirically correlated dimensions of adversity?

Do the types of hidden talents that develop, and when these abilities develop, depend on the timing of adversity exposures?

Which abilities are enhanced by early-life conditions, which ones by a combination of early-life and current conditions, and which ones by current conditions?

Which abilities are enhanced by environmental harshness, which ones by environmental unpredictability, and which ones by a combination of both?

What exactly distinguishes a hidden talent from other adaptations that develop in response to adverse conditions?

Which statistical criteria should be used to determine whether people show enhanced performance on a cognitive task? If response bias leads to a higher payoff, should we refer to this bias as a hidden talent?

What do hypotheses about hidden talents predict about variation in performance both within and between individuals when impairment and adaptation operate in concert?

In terms of test settings and materials, which dimensions of ecological validity enhance or impair the expression of hidden talents?

How can the adaptive value of hidden talents be tested in the real world?

How can utilizing hidden talents help people from adverse conditions in education and the workplace?

When is it appropriate in studies of hidden talents to statistically control for, or to exclude individuals on the basis of, impairments or psychopathology?

15. Palmer, C.T. and Tilley, C.F. (1995) Sexual access to females as a motivation for joining gangs: an evolutionary approach. *J. Sex. Res.* 32, 213–217
16. Belsky, J. *et al.* (1991) Childhood experience, interpersonal development, and reproductive strategy: an evolutionary theory of socialization. *Child Dev.* 62, 647–670
17. Ellis, B.J. and Del Giudice, M. (2019) Developmental adaptation to stress: an evolutionary perspective. *Annu. Rev. Psychol.* 70, 111–139
18. Gibb, B.E. *et al.* (2009) Reported history of childhood abuse and young adults' information processing biases for facial displays of emotion. *Child Maltreat.* 14, 148–156
19. Pollak, S.D. *et al.* (2009) Development of perceptual expertise in emotion recognition. *Cognition* 110, 242–247
20. Pollak, S.D. and Sinha, P. (2002) Effects of early experience on children's recognition of facial displays of emotion. *Dev. Psychol.* 38, 784–791
21. Goodman, G.S. *et al.* (2019) Trauma and long-term memory for childhood events: impact matters. *Child Dev. Perspect.* 13, 3–9
22. Rieder, C. and Cicchetti, D. (1989) Organizational perspective on cognitive control functioning and cognitive-affective balance in maltreated children. *Dev. Psychol.* 25, 382–393
23. Belsky, J. *et al.* (1996) Infant attachment security and affective-cognitive information processing at age 3. *Psychol. Sci.* 7, 111–114
24. Frankenhuis, W.E. and Bijlstra, G. (2018) Does exposure to hostile environments predict enhanced emotion detection? *Collabra Psychol.* 4, 18
25. McCoy, D.C. *et al.* (2015) Children's cognitive performance and selective attention following recent community violence. *J. Health Soc. Behav.* 56, 19–36
26. Piff, P.K. *et al.* (2018) Unpacking the inequality paradox: the psychological roots of inequality and social class. *Adv. Exp. Soc. Psychol.* 57, 53–124
27. Brienza, J.P. and Grossmann, I. (2017) Social class and wise reasoning about interpersonal conflicts across regions, persons and situations. *Proc. R. Soc. Lond. B Biol. Sci.* 284, 20171870
28. Ein-Dor, T. and Perry, A. (2014) Full house of fears: evidence that people high in attachment anxiety are more accurate in detecting deceit. *J. Pers.* 82, 83–92
29. Shoda, T.M. and McConnell, A.R. (2013) Interpersonal sensitivity and self-knowledge: those chronic for trustworthiness are more accurate at detecting it in others. *J. Exp. Soc. Psychol.* 49, 440–443
30. Pitula, C.E. *et al.* (2017) To trust or not to trust: social decision-making in post-institutionalized, internationally adopted youth. *Dev. Sci.* 20, e12375
31. Frankenhuis, W.E. *et al.* (2018) Does exposure to psychosocial adversity enhance deception detection ability? *Evol. Behav. Sci.* 12, 218–229
32. Frankenhuis, W.E. *et al.* (2019) Hidden talents in harsh conditions? A preregistered study of memory and reasoning about social dominance. *Dev. Sci.* Published online April 19, 2019. https://doi.org/10.1111/desc.12835
33. Bath, K.G. (2020) Synthesizing views to understand sex differences in response to early life adversity. *Trends Neurosci.* Published online March 16, 2020. https://doi.org/10.1016/j.tins.2020.02.004
34. Ellwood-Lowe, M.E. *et al.* (2018) Time-varying effects of income on hippocampal volume trajectories in adolescent girls. *Dev. Cogn. Neurosci.* 30, 41–50
35. Taylor, S. *et al.* (2000) Biobehavioral responses to stress in females: tend-and-befriend, not fight-or-flight. *Psychol. Rev.* 107, 411–429
36. Kraus, M.W. *et al.* (2012) Social class, solipsism, and contextualism: how the rich are different from the poor. *Psychol. Rev.* 119, 546–572
37. Mullainathan, S., Shafir, E., eds (2013) *Scarcity: Why Having Too Little Means So Much*, Macmillan
38. Frankenhuis, W.E. *et al.* (2018) Echoes of early life: recent insights from mathematical modeling. *Child Dev.* 89, 1504–1518
39. Ellis, B.J. *et al.* (2009) Fundamental dimensions of environmental risk: the impact of harsh versus unpredictable environments on the evolution and development of life history strategies. *Hum. Nat.* 20, 204–268
40. Fenneman, J. and Frankenhuis, W.E. (2020) Is impulsive behavior adaptive in harsh and unpredictable environments? A formal model. *Evol. Hum. Behav.* Published online March 14, 2020. http://doi.org/10.1016/j.evolhumbehav.2020.02.005
41. Mittal, C. *et al.* (2015) Cognitive adaptations to stressful environments: when childhood adversity enhances adult executive function. *J. Pers. Soc. Psychol.* 109, 604–621
42. Pope, S.M. *et al.* (2019) Enhanced cognitive flexibility in the seminomadic Himba. *J. Cross-Cult. Psychol.* 50, 47–62
43. Nweze, T. *et al.* Working for the future: parentally deprived Nigerian children have enhanced working memory ability. *J. Child Psychol. Psyc.* http://doi.org/10.1111/jcpp.13241 (in press)
44. Young, E.S. *et al.* (2018) Can an unpredictable childhood environment enhance working memory? Testing the sensitized-specialization hypothesis. *J. Pers. Soc. Psychol.* 114, 891–908
45. Bagot, R.C. *et al.* (2009) Maternal care determines rapid effects of stress mediators on synaptic plasticity in adult rat hippocampal dentate gyrus. *Neurobiol. Learn. Mem.* 92, 292–300
46. Champagne, D.L. *et al.* (2008) Maternal care and hippocampal plasticity: evidence for experience-dependent structural plasticity, altered synaptic functioning, and differential responsiveness to glucocorticoids and stress. *J. Neurosci.* 28, 6037–6045
47. Oomen, C.A. *et al.* (2010) Severe early life stress hampers spatial learning and neurogenesis, but improves hippocampal synaptic plasticity and emotional learning under high-stress conditions in adulthood. *J. Neurosci.* 30, 6635–6645
48. Leonard, J.A. *et al.* (2015) Differential effects of socioeconomic status on working and procedural memory systems. *Front. Hum. Neurosci.* 9, 554
49. Schwabe, L. and Wolf, O.T. (2013) Stress and multiple memory systems: from 'thinking' to 'doing'. *Trends Cogn. Sci.* 17, 60–68
50. Vogel, S. *et al.* (2016) Cognitive adaptation under stress: a case for the mineralocorticoid receptor. *Trends Cogn. Sci.* 20, 192–203
51. Dang, J. *et al.* (2016) When the poor excel: poverty facilitates procedural learning. *Scand. J. Psychol.* 57, 288–291
52. Ellwood-Lowe, M.E. *et al.* (2016) The application of neuroimaging to social inequity and language disparity: a cautionary examination. *Dev. Cogn. Neurosci.* 22, 1–8
53. Modecki, K.L. *et al.* (2020) Exposure to violence and neglect images differentially influences fear learning and extinction. *Biol. Psychol.* 151, 107832
54. Steudte-Schmiedgen, S. *et al.* (2014) Trauma exposure is associated with increased context-dependent adjustments of cognitive control in patients with posttraumatic stress disorder and healthy controls. *Cogn. Affect. Behav. Neurosci.* 14, 1310–1319
55. Levy-Gigi, E. *et al.* (2016) The hidden price and possible benefit of repeated traumatic exposure. *Stress* 19, 1–7
56. Schliemann, A.D. and Carraher, D.W. (2002) The evolution of mathematical reasoning: everyday versus idealized understandings. *Dev. Rev.* 22, 242–266
57. Carraher, T.N. *et al.* (1985) Mathematics in the streets and in schools. *Brit. J. Dev. Psychol.* 3, 21–29
58. Demir, Ö.E. *et al.* (2015) Parental socioeconomic status and the neural basis of arithmetic: differential relations to verbal and visuo-spatial representations. *Dev. Sci.* 18, 799–814
59. Richter, L. and van der Walt, M. (1996) The psychological assessment of South African street children. *Africa Insight* 26, 211–220
60. Dahlman, S. *et al.* (2013) Cognitive abilities of street children: low-SES Bolivian boys with and without experience of living in the street. *Child Neuropsychol.* 19, 540–556
61. Suor, J.H. *et al.* (2017) A life history approach to delineating how harsh environments and hawk temperament traits differentially shape children's problem-solving skills. *J. Child Psychol. Psyc.* 58, 902–909
62. Richard, B.A. and Dodge, K.A. (1982) Social maladjustment and problem solving in school-aged children. *J. Consult. Clin. Psych.* 50, 226–233
63. Sternberg, R.J. (2014) The development of adaptive competence: why cultural psychology is necessary and not just nice. *Dev. Rev.* 34, 208–224
64. Goudeau, S. and Croizet, J.C. (2017) Hidden advantages and disadvantages of social class: how classroom settings reproduce

How should the hidden talents approach build bridges with neuroscience? How can knowledge from neuroscience inspire hypotheses about hidden talents?

Which existing formal models from biology can inform the theoretical foundations of the hidden talents approach?

Which novel formal models should be built to advance knowledge about hidden talents?

social inequality by staging unfair comparison. *Psychol. Sci.* 28, 162–170
65. Richardson, G.B. *et al.* (2016) Ecological and evolutionary principles for secondary education: analyzing career and tech ed. *Evol. Behav. Sci.* 2, 58–69
66. Rogoff, B. *et al.* (2017) Noticing learners' strengths through cultural research. *Perspect. Psychol. Sci.* 12, 876–888
67. Bateson, M. *et al.* (2011) Anxiety: an evolutionary approach. *Can. J. Psychiat.* 56, 707–715
68. Haselton, M.G. and Buss, D.M. (2000) Error management theory: a new perspective in cross-sex mind reading. *J. Pers. Soc. Psychol.* 78, 81–91
69. McKay, R.T. and Efferson, C. (2010) The subtleties of error management. *Evol. Hum. Behav.* 31, 309–319
70. Nettle, D. (2012) Error management. In *Evolution and the Mechanisms of Decision Making* (Hammerstein, P. and Stevens, J.R., eds), pp. 69–79, MIT Press
71. Crick, N.R. and Dodge, K.A. (1994) A review and reformulation of social information-processing mechanisms in children's social adjustment. *Psychol. Bull.* 115, 74–101
72. De Castro, B.O. *et al.* (2002) Hostile attribution of intent and aggressive behavior: a meta-analysis. *Child Dev.* 73, 916–934
73. De Castro, B.O. and van Dijk, A. (2018) 'It's gonna end up with a fight anyway': social cognitive processes in children with disruptive behavior disorders. In *Wiley Handbook of Disruptive and Impulse-Control Disorders* (Lochman, J.E. and Matthys, W., eds), pp. 237–254, John Wiley & Sons
74. Trimmer, P.C. *et al.* (2017) The erroneous signals of detection theory. *Proc. R. Soc. Lond. B Biol. Sci.* 284, 20171852
75. Stamps, J. and Frankenhuis, W.E. (2016) Bayesian models of development. *Trends Ecol. Evol.* 31, 260–268
76. Malhi, G.S. *et al.* (2019) Modelling resilience in adolescence and adversity: a novel framework to inform research and practice. *Transl. Psychiatry* 9, 316
77. Masten, A.S. (2014) *Ordinary Magic: Resilience in Development*, Guilford
78. Barbarin, O.A. *et al.* (2019) Promoting social justice for African-American boys and young men through research and intervention: a challenge for developmental science. *Appl. Dev. Sci.* Published online December 26, 2019. https://doi.org/10.1080/10888691.2019.1702880
79. Gaylord-Harden, N.K. *et al.* (2018) Understanding development of African American boys and young men: moving from risks to positive youth development. *Am. Psychol.* 73, 753–767
80. Wilson, E.O. (1998) *Consilience: The Unity of Knowledge*, Vintage
81. Fanelli, D. (2010) 'Positive' results increase down the hierarchy of the sciences. *PLoS ONE* 5, e10068
82. Scheel, A.M. *et al.* (2020) An excess of positive results: comparing the standard psychology literature with registered reports. *PsyArXiv* Published online February 5, 2020. http://doi.org/10.31234/osf.io/p6e9c
83. Chambers, C. (2017) *The Seven Deadly Sins of Psychology: A Manifesto for Reforming the Culture of Scientific Practice*, Princeton University Press
84. Nosek, B.A. *et al.* (2018) The preregistration revolution. *Proc. Natl. Acad. Sci. U. S. A.* 115, 2600–2606
85. Gelman, A. (2017) Ethics and statistics: honesty and transparency are not enough. *Chance* 30, 37–39
86. Vazire, S. (2020) Do we want to be credible or incredible? *Observer* 33 January
87. Francis, G. (2014) The frequency of excess success for articles in psychological science. *Psychon. Bull. Rev.* 21, 1180–1187
88. Lakens, D. and Etz, A.J. (2017) Too true to be bad: when sets of studies with significant and non-significant findings are probably true. *Soc. Psychol. Pers. Sci.* 8, 875–881
89. Schimmack, U. (2012) The ironic effect of significant results on the credibility of multiple-study articles. *Psychol. Methods* 17, 551–556
90. Harms, C. and Lakens, D. (2018) Making 'null effects' informative: statistical techniques and inferential frameworks. *J. Clin. Transl. Res.* 3, 382–393
91. Aczel, B. *et al.* (2018) Quantifying support for the null hypothesis in psychology: an empirical investigation. *Adv. Methods Pract. Psychol. Sci.* 1, 357–366
92. Markant, J. *et al.* (2016) Selective attention neutralizes the adverse effects of low socioeconomic status on memory in 9-month-old infants. *Dev. Cogn. Neurosci.* 18, 26–33
93. Frankenhuis, W.E. and Nettle, D. (2020) The strengths of people in poverty. *Curr. Dir. Psychol. Sci.* 29, 16–21
94. Warren, S.M. and Barnett, M.A. (2020) Effortful control development in the face of harshness and unpredictability. *Hum. Nat.* 31, 68–87
95. Rosenblum, L.A. and Paully, G.S. (1984) The effects of varying environmental demands on maternal and infant behavior. *Child Dev.* 55, 305–314