Associations between Intelligence Quotient, Psychological Resilience and Low Socioeconomic Status: A Review

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Summary

The intelligence quotient (IQ) reflects the neurological networks of the brain, and is a useful proxy for human mental ability. Empirical evidence shows that IQ is an indicator of psychological resilience, definable as a dynamic process of positive adaptation to significant adversity. However, IQ and psychological resilience are multidimensional variables; and mediators in this association have to be considered.

Children from low socioeconomic status (SES) families are at relatively high risk of encountering adversity and have fewer resources to help them overcome crises. However, many maintain high-level physical and mental functioning across the lifespan. Research into the factors that promote resilience among low-SES children has potentially huge significance for social policy.

It has been shown that SES underlies the association between IQ and psychological resilience in children; better SES often indicates a higher IQ, but not necessarily better ability to cope with adversity. Unlike SES, IQ is a genetically determined variable; its variance across levels of SES is unclear. Some evidence has shown that children and adolescents from higher-SES families are more likely to inherit IQ than those from low-SES families, while other studies suggest that genetics influence IQ across all SES groups. Among low-SES children, who are relatively deprived of social and environmental resources, genetic components of IQ might have higher impact on psychological resilience.

The primary aim of this literature review is to critically evaluate the theoretical and empirical evidence about the association between IQ and psychological resilience in people from low-SES backgrounds. Its second aim is to identify research gaps for further empirical study.

Psychological Resilience

Adverse events-such as trauma, disease, loss of significant others and natural disasters-are associated with psychological problems such as stress, depression and anxiety, and post traumatic stress disorder (PTSD) [1]. However, resilient individuals who encounter such events are able to maintain high-level physical and psychological functioning [2]. This literature review focuses on psychological resilience, which can be defined as the mental and emotional capability to cope with adversity and to recover or maintain mental health [3,4].

Psychological resilience is multidimensional, and thus is associated with multiple protective and risk factors [5]. Empirical research to date has relied on models of resilience, one of the most common being the Five Part Model, which holds that optimism (cognition), emotional competence (emotional intelligence), adaptive health practice (behaviours/

physical activities), and social support (environment) interact to provide psychological resilience [6]. deTerte, et al. surveyed 176 police officers in New Zealand and again at 12 months and 10 years, and examined the five factors performance as predictors of psychological resilience after traumatic events [5]. Three factors (cognition, behaviour, and environment)

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were found to predict psychological resilience, so the authors proposed a simplified three part model. These results are not generalisable because the sample was homogeneous and had special occupational characteristics. In addition, the validity and reliability of the instruments or measurements applied in this study need to be confirmed.

To date, few scales are available for assessing psychological resilience in the general population. The validity and reliability of the Resilience Scale for Adults (RSA) were reported in a study of 482 military college applicants [7]. RSA was shown to accurately identify individuals who were psychologically healthy and had high resilience, but was not associated with cognitive abilities.

Psychological resilience has been characterised as heritable and inheritable. For example, a study of 1116 five-year-old twins in the United Kingdom investigated environmental and genetic contributions to psychological resilience in children from low-SES backgrounds. The findings demonstrated that resilience was heritable, but also a consequence of environmental factors, including maternal warmth, stimulating activities, and children's outgoing temperament [8].

The evidence to date confirms that psychological resilience is a multidimensional variable. Since there is no universally accepted measurement for psychological resilience, research designs and methodologies must be examined carefully to determine whether research findings are comparable.

Intelligence

Like resilience, intelligence is a multi-dimensional psychological construct. The intelligence quotient (IQ) is "a standard measure of an individual's intelligence level based on psychological tests". According to Charles Spearman's Two-Factor Theory of intelligence, general intelligence relates to the capacity for abstract thinking and reasoning, while specific intelligence refers to domains such as working memory and attention [9].

Scientists have worked for many decades to create and validate tools for measuring IQ, and the reference ranges of IQ tests for the general population are well established. The most widely used assessment tools for IQ are the Wechsler Intelligence Scale (WIS) for children [10] and the Wechsler Memory Scale for adults [11]. The scales have been revised multiple times according to updated empirical data [12,13]. IQ tests have been used to predict academic and career achievement [14] and for identifying the gifted or mentally disabled [15,16]. Nonetheless, IQ tests as evaluation tools for human mental abilities have been criticised, because it is unclear whether IQ tests results reflect true human intelligence [12,17].

To avoid inappropriate use, in Australia only qualified clinical psychologists can conduct traditional IQ tests [18]. For this reason, IQ tests are expensive in the clinical setting, while in research settings, those data from IQ tests are limited, expensive and time-consuming. Computer-based neuropsychological batteries are often used as proxies for IQ tests in large-scale studies [12].

Cognitive function is defined as the "intellectual or mental process whereby an organism obtains knowledge", and consists of general and specific domains. General cognitive function is commonly assessed in research settings using the mini-mental state examination (MMSE) [19], a valid and reliable tool. However, there are no universally recognised criteria for its use in clinical settings. Specific cognitive domains "include memory, learning, attention/executive function, information processing, psychomotor function and language". Computer-based neuropsychological tests have been developed to evaluate cognitive function in these domains. Computer-based batteries are easily administered and able to detect subtle individual differences. However, because batteries have different designs, inconsistent scoring systems and large variations in validity and reliability, results are generally not comparable across studies [20].

Definitions of intelligence and cognitive function overlap [21,22], because both measure learning, language, reasoning and problem-solving. Cognitive function is considered an underlying mechanism of intelligence [23]. Evidence has shown that intelligence mediates cognitive change trajectories with advancing age, particularly in the domains of perceptual and motor speed and spatial and verbal ability [24]. Information processing ability was shown to predict general intelligence in participants in an experimental assessment of temporal and pitch discrimination [25].

Despite the evidence demonstrating the overlap of IQ and cognitive function, there are debates about whether the results of neuropsychological cognitive tests are valid proxies for IQ. There are many types of intelligence tests serving various purposes, so it is unlikely that cognitive and intelligence tests are interchangeable. Research has found that correlations between cognitive test results are lower in people with higher IQ, suggesting that cognitive ability is more homogeneous in individuals of low IQ and specific in people with high IQ. Although concepts, definitions and assessment tools have been updated and modified during decades, and cognitive function and IQ overlap in their definitions, scope and methods of assessment, the two concepts are fundamentally different and cannot be confused [26].

Associations between Intelligence Quotient and Psychological Resilience

Because neither IQ nor psychological resilience has a universally recognised definition, the assessment tools for these variables vary. Research designs, participants' characteristics and methodologies have to be examined carefully in order to compare studies and draw conclusions about relationships between these concepts.

Early studies observed higher IQ and resiliency in children who displayed better regulating behaviours. A double-blind experimental study of 104 14-year-olds in the United States (US) investigated their ability to delay gratification (reject immediate rewards in favour of greater future rewards); children who exhibited higher ability to delay gratification had higher IQ (assessed using WISC; Wechsler, 1974) and ego resiliency (assessed using the California Child Q-Set),

highlighting the fundamental significance of both high-order cognitive function and resilience for impulse control [27]. This study found a positive association between IQ and psychological resilience, but a causal relationship cannot be assumed. Human behaviours in experimental settings have to be interpreted carefully when attempting to predict behaviour patterns in real life [28,29].

A subsequent longitudinal study in the US suggested that IQ and resilience were separate conceptual constructs [30]. This study investigated the relationship between IQ (Wechsler Adult Intelligence Scale-Revised) and ego resilience (An Inventory Scale to Index Ego Resilience) in 95 participants (aged 18-23; 49 women). The results suggested that both higher ego-resilience and IQ contributed in allowing individuals to adapt to complex life events, independent of demographic factors such as sex.

Other authors investigated the independent relationship between IQ and resilience after systematically considering potential confounders and modifiers. Tiet, et al. (1998) examined several factors hypothesised to be related to resilience in youth aged 9-17 years. They found that, beyond factors such as family functioning and parental monitoring, IQ was related to coping skills in children and adolescents at high risk of psychopathology and psychological dysfunction; however, IQ had no effect on coping for those at low risk of mental health problems. IQ's influence could be affected by varying severity of adversity, which these researchers did not examine due to the cross-sectional nature of their study.

Few researchers have investigated the long-term protective role of IQ with respect to adversity during childhood. A prospective study in Australia examined factors associated with resilience in 648 high-functioning children with no history of depression in the context of maternal depression. This study found that IQ (WISC-III; Wechsler, 1991) was a protective factor for children's resilience (among children with no internalising and externalising problems and no mental disorders), and its effect persisted from adolescence to early adulthood (20 years) [31]. However, evidence in support of IQ as an indicator of psychological resilience across the lifespan remains scarce.

Although IQ has strong genetic components, environmental adversity can reduce it. A Sweden study explored resilience among 80 refugee children (aged 6-17), and found that parental PTSD affected their IQ scores [32]. Further, childhood trauma can simultaneously affect IQ and resilience. A cross-sectional and population-based study in Sweden involved 465,249 men born during 1973-1983 who reported for military service at 18 years of age. It found that diagnosis of cancer in the men's parents was associated with low IQ and low resilience [33].

Although the concepts, definitions and assessment tools employed in the studies reviewed above differ slightly, they were developed in a chronological and consistent manner. Therefore, the studies are comparable. Overall, cross-sectional evidence suggests a positive association between IQ and psychological resilience, and longitudinal studies confirm that IQ is an indicator of psychological resilience. However, more work is needed to describe and analyse the underlying biological/neurological and social mechanisms.

Neurological Mechanisms

The neurological mechanisms underlying the associations between IQ and resilience have been investigated in brain imaging studies. Vythilingam, et al. recruited 11 male US soldiers on active duty (Caucasian, mean age 39 years) and examined the factors that contributed to their resilience to trauma. The soldiers' brains were scanned using magnetic resonance imaging (MRI) or functional MRI (fMRI) during a monetary incentive delay task. The findings suggested that the patterns of activation for this group of resilient soldiers were unique and revealed enhanced brain rewards function than the control, which could underpin resilience to severe trauma. In this study the IQ between the two groups were significant different. Presumably higher IQ was associated with "patterns of activation" or "brain reward [34].

Another study aimed to provide neuroimaging evidence for the links between human intelligence (higher-order cognition) and brain resilience in healthy adults (N = 102, ages 20-59). The findings suggested that regions for language and memory processing networks support resilience in individuals with higher IQ, while regions for emotional processing were more likely to be activated in low-IQ individuals [35].

Note that the replicability of brain imaging studies is poor due to their high financial cost and small sample sizes [36]. The generalisability of fMRI studies is also limited, because the research models applied to date have been simple and mostly conducted in experimental scenarios [37]. fMRI studies are valid for assessing brain structure or size, but are less likely to characterise the brain plasticity that seems to reflect resilience [38]. Moreover, different aspects of resilience have been found to be associated with different neurobiological changes [39], so further research is needed.

Social Mechanisms

Socioeconomic status is known to be associated with physical and mental health outcomes. Further, SES has a strong association with executive function (an important domain of cognitive function that includes working memory, inhibition and cognitive flexibility) in children [40]. Evidence suggests that SES is a predictor of IQ. For example, a longitudinal study in the US [41] reported that living in a racially segregated and disadvantaged neighbourhood contributed to the decline of IQ scores in children in early school years. SES was a more important determinant of performance on an IQ test than individual or family factors. In contrast, a prospective study involving 73 low-SES males (mean IQ = 80) and a control sample of 38 men with mean IQ of 115, followed from the age of 14 to 65 years, found that IQ was not positively and significantly associated with adult income and education levels. Personality traits were found to contribute strongly to the resilience of the low-SES group [42].

There is an interaction between SES, IQ and life outcomes. A prospective study of 456 men from US inner-city backgrounds, followed from 14 (± 2) to 65-years-old, examined

the contributions of various childhood factors to their career status across the life span. This study found that parental social status contributed more at the age of 25 than at later ages, while childhood development, including IQ, was a more important factor than parental SES during the lifespan [43].

Wingo, et al. investigated the associations between neurocognitive performance (Reynolds Intellectual Assessment Scales) and resilience to childhood trauma in 226 low-SES participants aged 18-75 years. The main funding of this cross-sectional study was that nonverbal memory was associated with resilience independent of sex, race and the severity of exposure to childhood trauma or abuse. However, the researchers tested only verbal and non-verbal memory and reasoning, so the results cannot be generalised to others cognitive domains. We cannot generalise the results in to IQ. In addition, this study did not include a control group from higher-SES families.

Psychological resilience and IQ have both heritable and non-heritable components requiring very different research methodologies, and thus researchers have investigated the underlying neurological and social mechanisms separately. The evidence to date about the brain functioning underlying the links between IQ and psychological resilience is weak. Additionally, evidence has shown that SES might interact with IQ associated with psychological resilience.

Conclusion

In this literature review, the concepts, definitions and measurements of IQ and psychological resilience were described and critically evaluated. Further, this review examined an interesting research question: "*Is a person who smarter, may also be stronger?*" [35]. The research literature suggests that there is an association between IQ and psychological resilience, but this association might be bi-directional. Within its normal range, IQ is likely to indicate psychological resilience, although it interacts with many other factors. Although numerous studies support a positive correlation between IQ and SES, the mechanisms underlying the association remain unclear. IQ reflects brain function, which might also be an underlying neurological mechanism for the link between IQ and psychological resilience. Importantly, evidence has shown that SES is an important social mechanism underlying the association. It is less clear whether, or to what extent, largely genetically influenced IQ is determined by family background. Note that all participants in studies described in the relevant literature were children or adolescents. Adult IQ is a measure of cognitive ability that predicts positive life outcomes. However, the effects of childhood SES on the association between adult IQ and psychological resilience are poorly understood.

Conflict of Interest

The authors declare that no competing interests exist.

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