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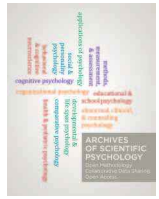

Beyond Questionable Research Methods: The Role of Omitted Relevant Research in the Credibility of Research

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A B S T R A C T

Governments often base social intervention programs on studies done by psychologists and other social scientists. Often these studies fail to mention other research suggesting that such interventions may have a limited chance of actually working. The omitted research that is not mentioned often shows that the behaviors and performances targeted for improvement by the environmental intervention programs are mostly caused by genetic differences between people and for that reason may be more difficult to change than implied in these studies. This is particularly true when the goal is to greatly reduce or eliminate differences between people in such domains as school achievement, impulsive behaviors, or intelligence. This problem of omitted research creates two problems. It tends to call into question the credibility of all social science research, even the studies that do not omit relevant research. And from an applied point of view, it leads to the expenditure of taxpayer dollars on programs that are unlikely to produce the desired outcomes.

S C I E N T I F I C A B S T R A C T

This article explores an important credibility problem in the research literature beyond the issue of questionable data analysis methods: the problem of omission of relevant previous research in published research articles. This article focuses on this problem in 2 areas: (a) studies purporting to demonstrate the effects of people's experiences on their later life outcomes while failing to discuss or mention the probable causal role of genetic inheritance in producing these effects, despite the strong evidence for this connection from behavior genetics research; and (b) studies of specific aptitudes (specific abilities) such as verbal, spatial, or reasoning that fail to acknowledge or mention that such aptitudes are indicator variables for general mental ability (GMA; or intelligence) and that after proper control for GMA the residuals in these aptitudes make essentially no contribution to prediction of real world academic, occupational, or job performance. It is only the GMA component in such aptitudes that produces the ability to predict. As is well known today, the issue of the credibility of research conclusions is prominent (Ioannidis, 2005). In both the areas examined in this article, these deficiencies create serious and unnecessary credibility problems, and the doubts they inspire about credibility could unfortunately be generalized to other research areas in which these problems do not exist.

Keywords: research credibility, behavior genetics, general mental ability, intelligence, specific abilities

In recent years there have been numerous published critiques of the credibility of research findings in psychology (and in other fields, such as medicine, pharmacology, economics, and others; e.g., Ioannidis, 2005; Schmidt & Oh, 2016; Simmons, Nelson, & Simonsohn, 2011). These critiques have focused on questionable statistical research methods and practices. However, many conclu-

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sions presented in research studies are questionable not because of the data analysis methods used, but because of the omission of relevant prior research findings; that is, failure to consider, discuss, or even mention well-established research findings that are highly relevant to the article's content and conclusions. This practice may typically be inadvertent and unintended, stemming from lack of knowledge of the relevant research findings. In such a case, this would be an example of a "lurking variable" (Joiner, 1981), a causal variable the researcher is unaware of. As pointed out by a reviewer, a second possible reason is that the researcher is aware of the relevant research but omits any discussion of it because he or she believes it runs counter to accepted sociopolitical views; this is the "political correctness" argument.

This article examines two areas of research in which this is a major problem: (1) the broad area of research on the effects of earlier experiences or exposures on later life outcomes, an area that covers many different areas of psychology and the social sciences; and (2) research on specific abilities (aptitudes). In both these areas, this failure threatens the credibility of the research.

Failure to Acknowledge Well-Established Behavior Genetics Findings

The first area of problem research focuses on the ostensible effects of life experiences on life outcomes. This broad area includes many research areas and topics in different psychological specialties. The aspect of much of this research that is problematic is the common failure to acknowledge the relevant findings in the field of behavior genetics. These findings show that virtually all tendencies, traits, behaviors, and life outcomes have a substantial genetic basis (cf. Bouchard, 1997a, 1997b, 2004; Colarelli & Arvey, 2015; Lee & McGue, 2016; McGue & Bouchard, 1998; Plomin, DeFries, Knopik, & Neiderhiser, 2013; Plomin, DeFries, Knopik, & Neiderhaise, 2016; Plomin, Owen, & McGuffin, 1994; Turkheimer, 2000). Even day-to-day variability in positive and negative affect has been shown to be substantially heritable (Zheng, Plomin, & von Stumm, 2016).

Research has further shown that most supposedly purely environmental variables (such as the number of books and magazines in the home) that are often concluded to be environmental causes of later life outcomes are themselves genetically influenced (e.g., see Plomin & Bergman, 1991; Plomin et al., 2016). That is, they are substantially influenced by the genetic makeup of the parents in the home, whose genes are passed on to their offspring. Research also indicates that people seek out and create their own environments based on their genetically influenced proclivities and interests (Scarr, 1996; Scarr, 1989; Scarr & McCartney, 1983).

The forgoing is a very brief overview but is believed to be sufficient to establish the main point. These behavior genetics findings do not mean that experiences of people do not have any effect on their later life outcomes. But they do mean that failure to even mention potential or likely genetic influences on these outcomes is a serious problem, one that reduces the credibility of the research. The following are some examples of studies that fail to acknowledge these well-established research findings.

A number of studies report that children who grow up in dysfunctional or abusive families tend later as adults to be abusive themselves (cf. Kaufman & Zigler, 1987, 1989). The interpretation is typically entirely environmental: It is assumed that the earlier experiences cause the later behavior. There is no acknowledgment of the fact that all major behaviors, including abusive personality tendencies, have a genetic component (Plomin, Owen, & McGuffin, 1994; Plomin et al., 2016; Turkheimer, 2000). There is no mention of the possibility that the genes that lead the parents to be abusive are passed on to their children and are an important reason why their children later themselves also become abusive as adults (Rowe, 1994). There are numerous examples of such studies in the literature (Kaufman & Zigler, 1987, 1989).

Warlaumont, Richards, Gilkerson, and Oller (2014) found that the parents of autistic children talk less to their children than other parents do; the article concludes that this is a cause (maybe the cause) of autism. There is no mention of genetics, despite the fact that autism has been shown to be strongly genetically influenced (Abrahams & Geschwind, 2008; Lord, Cook, Leventhal, & Amaral, 2000; Sigman & Capps, 1997; Plomin et al., 2013). It is possible that the reduced amount of talking to children among parents of autistic children is caused by one or both of the parents being on the weak end of the autism spectrum themselves and that their children are autistic for reasons of genetic inheritance. Stoltenberg and Burmeister (2000) pointed out that some behavioral abnormalities are present in the parents of autistic children and that these abnormalities "may be markers for some of the many predisposing genes for autism." Yet the Warlaumont et al. article contains no mention of any possible genetic connection.

Taylor, Manganello, Lee, and Rice (2010) found that 3-year old children who were spanked by their mothers showed more aggressive behavior at age 5 than children who had not been spanked. They concluded that the earlier spanking caused the later aggressive behavior. There was no mention of the possibility that the personality traits of the children were the causal variables at both time periods. The possibility that it is the most difficult, misbehaving, and aggressive children who are spanked and these difficult behaviors and the personality traits underlying them are stable and continue to manifest themselves at age 5 was pointed out by Baumrind (1997). As noted above, personality traits have a genetic basis. In a situation such as this there is also the possibility of passive gene–environment correlation. That is, parents and children may share genes that predispose both to personality traits (e.g., hostility, poor impulse control) that increase the likelihood of parental spanking. There is no mention of this possibility in the Taylor et al. (2010) study, either.

Waldinger and Schulz (2016) found that people who experienced nurturing family environments when young showed better emotion regulation styles as adults and were more secure in intimate relationships. In this article, the relations observed are interpreted as being completely due to environmental effects. There is no acknowledgment of the likelihood that the same genetic effects that cause the parents to generate a nurturing home environment are passed on to their children, causing them to show better adjustment later in life.

Several studies reported that children who are exposed to the classical music of Mozart have higher IQs (Campbell, 2001; Hetland, 2000). The implication is that the music caused the higher IQs. There is no mention in these studies of the possibility that parental general mental ability (GMA) and socioeconomic status (SES) are the real causes. Classical music is more often played in higher SES homes and parental GMA levels are higher on average in such homes. And GMA is highly heritable (about .75 in adulthood; Bouchard, 1997b; heritability varies somewhat by social class, and is higher than .75 in the elderly). When experimental studies were conducted that controlled for this, the Mozart Effect was found to be nonexistent (Steele, Bass, & Crook, 1999). Nevertheless, these reports led Governor Zell Miller of Georgia to arrange for all families with children in that state to receive a CD of Mozart's music and other classical music (History .com, 2010; Mackenzie, 1999).

Scarr (1996) noted that several studies report that authoritative parenting produces well-adjusted children, whereas authoritarian parenting results in children who are more prone to behavior problems

and have lower school achievement. In these studies, there is no discussion of the likelihood that parental GMA is the cause of this relation. Higher GMA parents are more likely to use authoritative parenting styles and lower GMA parents are more likely to use authoritarian parenting styles (Scarr, 1996). Both GMA (Bouchard, 1997b) and Authoritarianism (Waller, Kojetin, Bouchard, Lykken, & Telligen, 1990) are genetically influenced, and children can inherit both from their parents.

As discussed by Scarr (1989), some studies report that children of parents who read to them have higher IQs (GMA) and better school achievement. The implication is that the reading is the cause of the higher IQs. In fact, this linkage is probably substantially genetic in nature. Higher GMA parents are more likely to read to their children, and their children are more likely to inherit genes that contribute to higher GMA. Scarr (1989) showed that the strongest link with the child's IQ was the average IQ of the parents. After controlling for this there was essentially no relation between the child's IQ and any of a number of parental characteristics or child rearing practices (e.g., parental knowledge of child development; parental education; mother's positive discipline; mother's positive control). Other studies that fail to recognize the genetically causative role of parental GMA on abilities, characteristics, and behaviors of their children include Brown, Mounts, Lamborn, and Steinberg (1993); Darling and Steinberg (1993); DeBaryshe, Patterson, and Capaldi (1993); Durbin, Darling, Steinberg, and Brown (1993); Tang, Davis-Kean, Sexton, and Chen (2016); and Wachs and Gruen (1982).

An article by Chen and Miller (2012) attempts to explain why some children growing up in extremely disadvantaged circumstances nevertheless do well and even thrive. The explanation they present is entirely in terms of environmental effects, such as the influence of mentors on their development of strategies for dealing with adversity. There is no mention of potentially relevant personality traits, such as extroversion or conscientiousness, which are substantially heritable (around .50; Bouchard, 1997b). Nor is there any discussion of the potential role of GMA, which is even more heritable (about .75 in adulthood; higher in the elderly; Bouchard, 1997b). In fact, there is no mention of any individual traits the might contribute to resilience.

Bank, Burraston, and Snyder (2004) reported that coercive parenting and frequent conflicts with siblings are linked to antisocial behavior and peer difficulties in children. The interpretation is that these effects are caused by the children's experience of coercive or ineffective parenting. There is no mention of the likely role of genetics. The personality traits of disagreeableness, neuroticism, and authoritarianism are quite heritable (heritabilities are about .50; Bouchard, 1997b). Parents who are coercive are likely to be high on one or more of these traits and their children can inherit these same tendencies, leading them to engage in more conflict with their siblings and to show more antisocial behaviors. Other studies manifesting this problem include MacKinnon-Lewis, Starnes, Volling, and Johnson (1997); McLaughlin, Kubzansky, Dunn, et al. (2010), and McLaughlin, Sheridan, Alves, and Mendes (2014).

A study by Daly, Egan, Quigley, Delaney, and Baumeister (2016), based on 21,132 individuals, found that self-control in childhood (at age 10) predicted ability to refrain from smoking in adulthood. This study included a partial control for cognitive ability but no control for potentially relevant personality traits (which, as noted earlier, have substantial genetic components). For example, there was no mention that the causal variable here could have been the personality trait of Conscientiousness, which could produce both childhood self-control and later ability to resist the temptation to smoke (self-control in adulthood).

The subjects in Davis et al. (2016) were Latino adolescents who were recent immigrants to the United States. The study found that those who reported feelings of being discriminated against showed more depressive symptoms and displayed fewer prosocial behaviors. The interpretation was that the "experience of discrimination" causes depression and reduces prosocial behaviors. There was no mention of the possible role of the genetically influenced personality trait of neuroticism. The anxiety and other negative emotions characteristic of neuroticism could be the cause of both the perceptions of discrimination and the depressive symptoms, with the symptoms of depression being the cause of the reduction in prosocial behaviors. (See Lilienfeld, 2017, for a summary of the effects of personality traits on individuals' perceptions and reactions.) Neuroticism, like other personality traits, has been shown to have a substantial genetic component. The trait of neuroticism, and especially the negative affectivity and negative emotionality that goes with it, may be the cause of many of the more specific manifestations, such as general pessimism, feelings of work related stress, and job dissatisfaction. Arvey, Bouchard, Jr., Segal, and Abraham (1989) demonstrated that job satisfaction has a genetic component, which seems to explain why job satisfaction (or dissatisfaction) does not change much as the individual moves from one job to another. It seems likely that the basis for this genetic component in job satisfaction is the personality trait of neuroticism. The book edited by Colarelli and Arvey (2015) explored genetic influences on a variety of organizational behaviors.

The social consequences of this problem in research studies can be serious. One consequence is widespread public belief in false causal connections. For example, consider the finding that people who drink wine are healthier and live longer on average than people who drink other alcoholic beverages. The proposition expressed or implied in such articles is that drinking wine causes health and longevity. The real cause is likely to be SES. Higher SES people are more likely to prefer wine. They also have better health in general and better health care, both self-care and medical care. And SES is itself partially genetically determined (Belsky, et al., 2016; Judge, Klinger, & Simon, 2010; Plomin et al., 2013). Bouchard (1997b) reported an average heritability of .45 for SES (measured as occupational status). SES is also substantially correlated with GMA, which has an even larger genetic loading. There are other such examples, many of which are illustrated in the studies described above. Widespread false causal beliefs in the general population can cause many problems, especially in an active democracy in which many organizations advocate and implement interventions intended to improve human welfare. Wasted spending on intervention programs that have no causal effect may occur with some frequency. Examples would include a campaign to get people to switch from other alcoholic beverages to wine and Governor Zell Miller's program to provide classical music CDs to all Georgia families with young children. And some interventions might actually cause harm to their recipients (Lilienfeld, 2007; Wilson, 2011).

Another social consequence of this problem is widespread overestimation of the potential of interventions to reduce or eliminate individual differences in important traits or behaviors (intelligence, academic achievement, etc.). The goal of such interventions is often to reduce inequalities between individuals by increasing the standing of those in the below average range. The extent to which interventions can achieve this goal is likely to be overestimated by researchers and others who are unaware of the effects of genetic differences between individuals in producing these differences.

The degree to which individual differences on a trait are determined by genetics is expressed as the heritability coefficient, which measures the extent to which the variance in the trait across individuals at a

particular time in a particular society is due to genetic differences between individuals (e.g., cf. Plomin, Defries, et al., 2013; Plomin et al., 2016). For example, if heritability is .50, then 50% of the variance between individuals on this trait is due to genetic differences. The observed heritability of a typical personality trait (e.g., conscientiousness) is about .50 (Bouchard, 1994, 1997b; Holden, 1987). The square root of the heritability coefficient is the correlation between observed personality test scores and genes; for a heritability of .50, this square root is .71. This correlation is biased downward by measurement error in the personality scale measuring conscientiousness (e.g., see Lord & Novick, 1968 or Nunnally, 1967). Dividing this correlation by the square root of the reliability coefficient of the personality scale removes this bias. This reliability is, at most, .85 when properly computed (cf. Schmidt, Le, & Ilies, 2003). Making this bias correction (.71/.92) yields a correlation of .77. A correlation this large between a trait and underlying genes may place some constraints on the ability of any intervention to reduce individual differences (i.e., to reduce inequality among individuals). Many such correlations are larger than this. For example, if observed heritability is .60, the correlation is .84. If observed heritability is .70, the correlation is .91. So it appears that this is not a trivial constraint.

One example of this problem is the No Child Left Behind Act passed during the George W. Bush administration. This law had the goal of reducing inequality in academic achievement among schoolchildren by raising achievement levels among students scoring below average for their grade level. Academic achievement, as measured by standardized achievement tests, is a strong function of GMA, with correlations between the two ranging from .77 to .94 (Kaufman, Reynolds, Liu, Kaufman, and McGrew, 2012). Deary, Strand, Smith, and Fernandes (2007) examined the relation between GMA at age 11 and overall academic achievement at age 16 in 25 national academic subject examinations for over 70,000 English children. The correlation, corrected for measurement error biases, was found to be .81. GMA is itself highly heritable, with heritability coefficients ranging up to .80 in studies of identical twins separated at birth and reared apart (Bouchard, 2004, 1997a, 1997b), although values are somewhat lower for young children (Brody, 1992), and especially for low SES children (Turkheimer, Haley, Waldron, D'Onofrio, & Gottesman, 2003). The heritability of GMA increases with age and appears to be highest among older individuals (McLearn, 1997; Petrill et al., 1998). Further, educational achievement itself is highly heritable (.88; Bouchard, 1997b). Academic motivation is often discussed as a cause of academic achievement. But a study based on over 13,000 pairs of identical and fraternal twins from six countries found that the motivation to achieve academically also has a large genetic component (Kovas et al., 2015). In addition, neuroscience research has identified molecular gene sequences that are correlated with educational achievement and attainment (cf. Belsky et al., 2016; Davies et al., 2016). The implication of this research is that it may be more difficult for educational interventions to produce lasting decreases in individual differences in academic achievement than many have believed. However, it may not be impossible.

Heritability does not necessarily directly limit the extent to which overall means can increase or decrease. It is theoretically possible for the overall mean for a trait or behavior to increase or decrease with no reduction in individual differences on the trait or behavior in the group in question. Heritability does not address the overall average of a trait; it refers only to the differences between individuals in levels of a trait. This opens up the possibility that very thorough-going academic interventions administered only to low achieving students could reduce individual differences in academic achievement. If this were to happen, the next question would be whether these gains would be lasting. The experience with Head Start suggests they would not last beyond a few years (Brody, 1992).

Another social consequence of the problem addressed in this article is the undermining of the credibility of research, especially among informed individuals who are aware that correlation is not causation and/or are aware of some of the findings of behavior genetics research. This threat to credibility might generalize to all psychological research studies and is in addition to the threat caused by the questionable statistical data analysis methods that have been discussed at length recently in the literature (e.g., Ioannidis, 2005; Simmons, Nelson, & Simonsohn, 2011).

Failure to Acknowledge Well-Established Findings on Specific Abilities and GMA

The second area with the problem of omitted research focuses on individual aptitudes or specific abilities, such as verbal ability, spatial ability, working memory, and so forth. Each such aptitude or specific ability is an indicator variable for GMA (Carroll, 1993; Cattell, 1971; Gustafsson, 1984; Jensen, 1998; Schmidt, 2011). There are many such GMA indicator variables with varying levels of quality (i.e., information value about GMA). (Even general knowledge can be a strong indicator variable if comprehensively measured across many knowledge domains; Roznowski, 1987, and Schmidt, 2011). The larger the number of such indicator variables contained in a measure of GMA, the more complete and construct valid is the measure of GMA. After proper statistical control for GMA, the component of each of these abilities that remains adds essentially nothing to the prediction of real life performances (on the job, in school, in vocational training programs, etc.; Brown, Le, & Schmidt, 2006; Ree & Earles, 1991, 1992; Ree, Earles, & Teachout, 1994; Schmidt, Ones, & Hunter, 1992; Thorndike, 1985, 1986). It is only the GMA component in the specific ability that creates its ability to predict life outcomes. That GMA component in the specific aptitude exists because GMA is one cause of the specific aptitude.

Yet many published studies argue that a particular specific ability uniquely predicts life outcomes, without any reference to GMA. For example, some studies conclude that spatial aptitude predicts performance in STEM (science, technology, engineering, and math) fields. Some such studies make no mention of a control for GMA. And some present a partial and incomplete "control" for GMA. For example, a short test of vocabulary (e.g., 10 items) might be used to represent GMA. There are two problems with this practice. First, this is only one of the many indicator variables for GMA, so this measure is a construct-deficient measure of GMA. A construct valid measure of GMA requires use of multiple indicator variables (e.g., cf. Carroll, 1993; Gustafsson, 1984; Jensen, 1998; Schmidt, 2011). Second, such studies do not control for the biasing effects of measurement error, effects that have long been known (Guilford, 1954; Lord & Novick, 1968; Magnusson, 1966; Nunnally, 1967) and which have been reiterated and re-emphasized in the literature more recently (Brown et al., 2006; Schmidt et al., 2003; Schmidt & Hunter, 1996, 1999, 2015; Westfall & Yarkoni, 2016). All measures contain measurement error (Schmidt, 2010), so even a construct valid measure of GMA is not free of measurement error. Without a correction for the biasing effects of measurement error, the control for GMA is only partial. That is, only part of the effect of GMA is removed from the specific aptitude measures in the simultaneous regression equation; the rest of the GMA effect remains, causing a false indication that the specific aptitude makes a contribution to prediction beyond the effect of GMA (cf. Brown et al., 2006; Westfall & Yarkoni, 2016). We have found no studies of this sort that have employed an adequate control for the

effect of GMA on the specific aptitude. And none of them discuss the biasing effects of measurement error.

One example of this occurs in the Study of Mathematically Precocious Youth Project (Clynes, 2016; Lubinski & Benbow, 2006; Lubinski, Benbow, & Kell, 2014; Lubinski, Benbow, Webb, & Bleske-Recheck, 2006; Makel, Kell, Lubinski, Putallaz, & Benbow, 2016), which concludes that spatial ability adds incremental prediction over and above GMA. However, the GMA measure used contains only two indicator variables for GMA (verbal and quantitative). A construct-valid GMA measure requires more than two indicators variables. The small observed increment in prediction from the addition of the spatial measure (Clynes, 2016) is what one would expect from adding a third GMA indicator variable, thereby increasing the construct completeness of the overall GMA measure. Finally, in these analyses, there is no correction for the biasing effects of measurement error (Brown et al., 2006; Schmidt et al., 2003; Schmidt & Hunter, 2015; Westfall & Yarkoni, 2016).

The investment theory of intelligence (cf., Cattell, 1971; Schmidt, 2011, 2014) explains why multiple indicators of GMA are required to obtain a complete, construct-valid measure of GMA. Individual interests and individual differences in interests develop relatively early in life and are quite stable over time (Holland, Fritzsche, & Powell, 1994; Kuder & Zytowski, 1988; Low, Yoon, Roberts, & Rounds, 2005; Scarr, 1989; Schmidt, 2011, 2014). They are also substantially heritable (heritability is about .45; Bouchard, 1997b). An individual's interests determine which specific abilities or aptitudes the individual invests his or her GMA in developing. For example, someone with strong literary interests will read extensively and invest much of his or her GMA in the development of verbal ability—vocabulary, reading comprehension, literature, and writing skills. Someone with strong practical or technical interests will invest more GMA in the development of mechanical and spatial ability. Someone with strong general scientific interests will invest more GMA in acquisition of general scientific knowledge (a good indicator of GMA; cf. Schmidt, 2011) and often mathematical and spatial ability. Because different individuals invest their GMA in the development of different specific abilities or aptitudes, it is important to sample multiple indicators of GMA (corresponding to the interests that vary across individuals) to achieve a GMA measure that truly represents GMA; that is, a construct-valid measure of GMA (Cattell, 1971; Gustafsson, 1984; Jensen, 1984, 1998; Schmidt, 2011).

GMA is not a speculative or merely hypothetical construct. It is arguably the most well-established scientific construct in psychology and is comparable in standing to constructs in the physical sciences (Bouchard, 2014; Deary, 2002; Jensen, 1984). GMA is strongly genetically influenced, with an adult heritability of about .75 (Bouchard, 2004, 1997a, 1997b; Bouchard & McGue, 1981; McGue & Bouchard, 1998). (Interestingly, the evidence indicates that the more culture-dependent an ability is, the higher its heritability is, Kan, Wicherts, Dolan, & van der Maas, 2013, which is counter to decades of theorizing about culture-free and culture-fair tests.) At the molecular genetic level, DNA markers have been identified that account for most of the influence of genes on GMA (Plomin et al., 2013). Also, there is apparently a physical basis for GMA in the brain: Neuroscience research has found important differences in brain structure and function between people who score high and low on GMA measures (Basten, Hilger, & Fiebach, 2015; Duncan et al., 2000; Haier, 2016; Haier, Jung, et al., 2004; Jung & Haier, 2007). GMA measures taken on high school seniors and others aged 15 to 22 predict job level attained 14 years later (Wilk, Desmarais, & Sackett, 1995; Wilk & Sackett, 1996). And in addition to predicting specific occupational, job, and school performances (Schmidt & Hunter, 2004), GMA also predicts the ability of people to perform nonjob tasks in everyday life (e.g., reading bus schedules and filling out required forms (Gottfredson, 1997b, 2002). In predicting job performance and performance in occupational training programs, GMA has been shown to be much more important than personality traits (Schmidt & Hunter, 2004; Schmidt, Shaffer, & Oh, 2008). These and other research findings (cf. Gottfredson, 1997a) support the reality of the GMA construct and its central role in human psychology. This support is why published studies that simply ignore GMA while focusing on specific aptitudes and abilities (i.e., individual GMA indicator variables) are lacking in credibility and are misleading.

Another example of a problem study is Grzywacz, Segel-Karpas, and Lachman (2016). This study examined the relationship between occupational complexity and three specific aptitudes (indicators of GMA): episodic memory, executive functioning, and general memory. They found that, in general, people in more complex occupations had higher scores on these three GMA indicators. There is no indication in this article that people who wind up in more complex, mentally demanding occupations tend to be higher in GMA (Schmidt & Hunter, 2004; Wilk et al., 1995; Wilk & Sackett, 1996) and that their findings might reflect the effects of GMA differences on their three indicator variables for GMA.

A third example is the study by Ma-Kellams and Lerner (2016). The dependent variable in this study was empathic accuracy in judging others. They referred to their two independent variables as "thinking styles." They state that some people use an intuitive, emotion-based style in judging others and other people use a rational style based on reasoning. They found that people who used a rational, reasoning approach were more accurate in their perceptions of others. There is no mention of the fact that reasoning is an indicator variable for GMA and that it is likely that it is the GMA influence reflected in reasoning that is responsible for their finding. In fact, the article contains no mention of GMA.

One indicator variable for GMA (i.e., one specific aptitude) is working memory; it is a quality indicator because its correlation with GMA is quite high (e.g., see Colom, Rebollo, Palacios, Juan-Espinosa, & Kyllonen, 2004). Working memory is measured as the ability to hold multiple items of information or objects in mind and to call them up to attention as needed in problem solving. Working memory has often been studied without any reference to its relationship to GMA, and studies have shown that working memory scores can be improved by specific training exercises, as is the case with other indicator variables for GMA (e.g., solving math or spatial problems). Such improvements in specific aptitudes have been found to not generalize or transfer to other aptitudes or to GMA itself. Some studies (e.g., Jaeggi, Buschkuehl, Jonidas, & Perrig, 2008) have claimed that improvements in working memory scores produced by training lead to improvement in GMA, a result that would not be expected given that working memory is just one of the many indicator variables for GMA. Chooi and Thompson (2012) conducted a careful, well designed study attempting to replicate these claims and found no evidence for such an effect. Recently, Melby-Lervåg, Bedick, and Hulme (2016) conducted a comprehensive meta-analysis of this literature based on 147 study outcomes. This meta-analysis found that working memory training does not improve performance on measures of GMA or on any other measures of "far transfer" (transfer to other abilities or mental tasks not identical to working memory tasks). If those involved in research on the working memory aptitude had initially recognized that working memory measures are simply one addi-

tional indicator of GMA a great deal of unnecessary research effort could have been avoided.

Studies of the sort we describe here do not present or discuss the well-established research findings on the hierarchical organization of mental abilities (with GMA at the top as the highest and general factor; Carroll, 1993; Gustafsson, 1984; Jensen, 1998). Nor do they discuss the well-established finding that specific GMA indicators contribute essentially nothing to prediction beyond GMA.

Studies like this are problematic both because the research summarized in this article on GMA and mental abilities is clearly available in the literature and is ignored; and because the biasing effects of measurement error and the methods for correcting for these biases have long been well known (Guilford, 1954; Lord & Novick, 1968; Magnusson, 1966; Nunnally, 1967) and have been reiterated and emphasized in the literature more recently (Brown et al., 2006; Schmidt & Hunter, 1996, 1999, 2015; Westfall & Yarkoni, 2016).

Making the problems in this area clear to the field of psychology is important because there are a large number of such problem studies in the psychological research literature; these studies are not only misleading in their conclusions, they can also reduce the general credibility of research on mental abilities.

Discussion

The purpose of this article is to draw attention to an important problem in the research literature beyond the issue of questionable statistical data analysis methods in research. That is the problem of the omission of relevant research findings in published research articles. This article has focused on this problem in two areas. The first area consists of studies purporting to demonstrate the effects of people's experiences on their life outcomes. Many studies drawing causal conclusions about these experiences fail to mention the probable causal role of genetic inheritance in producing these effects, despite the overwhelming evidence for this connection from behavior genetics research. The second area consists of studies of specific aptitudes (specific abilities) such as verbal, quantitative, and spatial, or reasoning. Many such studies fail to acknowledge or even mention that such aptitudes are indicator variables for GMA and that after proper control for GMA the residuals in these aptitudes make essentially no contribution to prediction of real world academic, occupational, or job performance. It is only the GMA component in such aptitudes that produces the ability to predict.

A reviewer suggested that research areas beyond the two examined in this article should be addressed. However, the first area examined here is very broad and includes research in many areas and specialties of psychology and the social sciences. These include the research areas of academic achievement, aggressive behavior, abusive behavior within families, failure in intimate relationships, authoritative versus authoritarian parenting, effects of parental reading on children, later effects of self-control displayed in childhood, and effects of personality traits on behaviors and perceptions. These multiple areas of research are all observational or correlational. Areas of experimental research are not included because (in theory) randomization of subject assignment controls for hidden or unrecognized causal variables (lurking variables; Joiner, 1981). However, experimental psychology research as typically found in the literature, although not subject to the problems examined in this article, has other serious problems; for example, see Schmidt and Oh (2016). In addition, Jussim, Crawford, Anglin, Stevens, and Duarte (2016) discussed the tendency in experimental social psychology for researchers to fail to consider alternative and plausible interpretations of their findings and pointed out that this omission reduces the credibility of their research conclusions.

The issue of the credibility of research conclusions is prominent today (Ioannidis, 2005). In both the areas examined in this article, these deficiencies create serious and unnecessary credibility problems, and the doubts they inspire about research credibility could unfortunately be generalized inappropriately to other research areas in which these problems do not exist. So it is important that this problem be addressed and corrected.

However, it is also important not to leave the impression that all studies have these problems. Studies can be found that are exemplary. One example is the study by Dinescu et al. (2016). This study examined the hypothesis that when people marry, their level of alcohol consumption decreases. They acknowledged that marriage per se might not be the causal variable and that people who marry might be genetically different from those who do not. So they controlled for genetic effects using a sample of 1,703 monozygotic and 722 dizygotic twins. Their results showed the even after controlling for genetic effects, people drank less after marriage than they had before marriage. Another exemplary study is Gotlib et al. (2015). This study found that apparently healthy women whose mothers suffered from depression had shorter telomeres and greater cortisol reactivity to stress than did women whose mothers had never been depressed. They acknowledged that this effect could be genetic or environmental or both, and they called for research to determine the relative contributions of genetic and environmental causes. There is another particularly important example. For over 25 years, Terrie Moffitt and Avshalom Caspi have conducted longitudinal research studies that have taken into account both genetic and environmental contributions to human behaviors. And in 2016 they received the Distinguished Scientific Contributions Award for this work from the American Psychological Association (Award for Distinguished Scientific Contributions, 2016). These and other examples in the literature show that it is possible to conduct research of the type called for in this article.

The hope is that the information presented in this article will lead to recognition in the literature of the role of behavior genetics findings in studies interpreting relationships between experiences and later life outcomes; and to recognition of the central role of GMA in studies examining specific aptitudes and abilities. At present the literatures in these two areas contain many studies that are scientifically incomplete. These changes are important for establishment of the credibility of research conclusions in these areas and may help to deter credibility losses across other areas of research.

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