g: The bedrock of skill acquisition, competence, and capacity for cognitive complexity in leader and leadership development

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Abstract

Intelligence (also known as general mental ability or g), as an explanatory construct, has been somewhat ignored in the study of human development in general and in leader development in particular. Studies of intelligence reveal it to be a strong predictor of academic, career, and life success. Researchers in the past have shown that intelligence also plays a role in predicting leadership emergence and effectiveness. Leader development, however, since it is properly nested in developmental (and organizational) psychology, tends to elicit the use of models and social processes to explain how leaders develop. In contrast, intelligence researchers have traditionally taken an individual differences approach. Evidence is herein presented which supports the validity of intelligence as a psychological scientific construct and demonstrates its association with academic, occupational, and life achievement. Then, in more speculative fashion, the literature dealing with leadership and leader development is explained, culminating in suggestions for a research agenda.
Intelligence itself has been the subject of study since the end of the 19th century; the large research literature explains the results of studies into its nature, associations, and processes. Leader development on the other hand, as a scientific construct, has not enjoyed the same amount of attention. Indeed, the construct itself represents something of a reaction to the study of leadership development. That is, some researchers in the field of leadership began to concentrate more on leaders as the focus of study rather than on the concepts which collectively comprise leadership (such as integrity, initiative, and vision). It is the task of this writer to explain what intelligence is, describe how it influences a variety of activities and processes, and connect it with specific aspects of leader development.

This submission consists of 10 sections. The first reviews the various definitions of intelligence. The second is concerned with how intelligence is measured (and why that matters). Section III compares and contrasts the various major theories of intelligence. The next section examines the effect of intelligence on workplace and life performance and success. The next four sections are concerned with leadership and development. Specifically, Section V reviews the literature on intelligence and leadership. Section VI addresses the limited research on the role of $g$ in human development to further set up Sections VII and VIII that examine the small literature on the relationship between intelligence and leader and leadership development, respectively (with attention paid to leader development itself and a theory of how intelligence relates to development itself). Section IX considers how the reviewed literature might influence leader development at USMA and in the US Army while Section X concludes with a summary and suggestions for future research.

A final note: This writer uses $g$, intelligence, IQ, and general mental ability interchangeably. The four terms are mostly synonymous, differing only in their degree of specificity. Strictly speaking, $g$ is a higher order factor extracted from a factor analysis. $g$, as a statistic, is said to stand for, or to represent, general mental ability. Intelligence is the more common or colloquial term. And IQ, or the Intelligence Quotient, is simply the calculated score from an intelligence test.

Section I: Definitions of Intelligence

Intelligence is one of the most studied phenomena in all of psychology (Jensen, 1980, 1986a, 1986b, 1998). It is presumed to influence academic achievement, occupational success, and a host of other social and personal variables (Herrnstein & Murray, 1994). With such a deep research base it might appear that the phenomenon is well-defined, but that is hardly the case. Sternberg and Detterman (1986) edited a book which had 21 authors submit essays describing the nature and definition of intelligence. Here are some of the submissions: Intelligence is a quality of behavior (Anastasi, 1986); it is the abilities in the achievement of rationally-chosen goals (Baron, 1981, 1986); it is the sum of the processes and products of learning (Brown & Campione, 1986); there are at least seven distinct abilities which assist in dealing successfully with the environment (Gardner, 1983; 1986); it is the general factor which is found in the correlation matrix of various cognitive measures and which is involved in all intellectual
functioning (Jensen, 1980, 1986a, 1986b); it is the use and understanding of scripts (Schank, 1986, 1990). Some contributors emphasized biological aspects which others concentrated on the cultural or contextual settings which influence cognition. In short, there is no wanting of definitions of intelligence.

This might, on the surface, make it appear that research into intelligence is atheoretical and directionless. In fact, in spite of the many different emphases on the various constructs associated with intelligent thinking and behavior, there is a remarkable amount of agreement on some of the essentials regarding intelligence. This is substantiated by the work of three sets of researchers.

In 1921 the editors of The Journal of Educational Psychology asked 14 prominent psychologists (such as Terman, Thorndike, and Thurstone) about their opinions on intelligence. As most of them were in schools of education, their interests lay in how intelligence could be measured effectively and how it influenced people’s performance on cognitive tasks. In 1986 Sternberg and Detterman (see Sternberg & Berg, 1986) repeated the 1921 symposium, only this time with a larger number of researchers with broader research interests. Although the first symposium showed a concern with psychometrics and the second symposium showed a concern with information processing, culture, and their complex interrelationship, there was much in common between the two sets of responses.

Experts at both symposia emphasized adaptation to the environment, the importance of some basic mental operations such as perception, higher-order thinking, the generality of intelligence, and successful responses as being very important to intelligence. Additionally, there was not much of a change in the area of unity versus diversity; that is, experts at both symposia continued to argue about the overall nature of intelligence, whether it was a single entity or if it consisted of layers, levels, parts, or was simply a collection of differing abilities (e.g., Gardner, 1983, for the latter and Jensen, 1980, for the former). Modern researchers place a considerably greater emphasis on culture, executive processing, and the exact role of knowledge in intelligent thinking.

Snyderman and Rothman (1987, 1988), at just about the same time, surveyed 661 experts in intelligence and intelligence-related research about their views on the subject. As with the Sternberg and Detterman (1986) study, there was considerable variation in opinion, but also large-scale agreement on many matters of import. For instance, 53 percent of respondents agreed that there was some form of consensus on the kinds of behaviors that are labeled “intelligent,” and regarding the elements of intelligence, 99 percent, 98 percent, and 96 percent, respectively, checked the following as important: abstract thinking or reasoning, problem-solving, and capacity to acquire knowledge. In sum, it seems that there is overall agreement regarding the generalities of intelligence, its purpose and expression, but not on the specifics, and those specifics include a description of its structure and essence.

Section II: Measurement of Intelligence
Definitional controversies aside, there is also considerable disagreement over whether intelligence can be measured accurately, if at all. The common metric of intelligence is IQ, the intelligence quotient. Intelligence tests typically consist of a wide variety of questions that tap into spatial, verbal, mathematical, and other areas. When these various components are factor analyzed, a general factor emerges. This general factor, or $g$, is purportedly a fair representation of the test-taker’s general intellectual ability. Researchers such as Jensen (1980, 1998) and Eysenck (1998) vigorously defend the validity of intelligence testing and of the strong relationship $g$ has with IQ. (Note that IQ is simply a test score while $g$ is an artifact from a factor analysis; they are not, in fact, the same. The IQ score, then, serves as a proxy for general mental ability.) According to Jensen (1980, 1998), the more a test loads on $g$, the better its predictive and criterion validity.

With a history that includes eugenic and racist policies (see Brody, 1992; Eysenck & Kamin, 1981) IQ has been challenged in regards to its validity, and some have even questioned its usefulness at all (Flynn, 1991; Gardner, 1983; Gould, 1996; but, see Carroll [1995] for a critique of Gould [1996]). With expansions in intelligence theorizing (Ceci, 1996; Gardner, 1983; Sternberg, 1985) it is only natural that tests of intelligence which were based on more narrow definitions of intelligence would come under scrutiny. Nevertheless, to date, no other construct in psychology has shown the predictive and explanatory capability that intelligence, as represented by IQ, has shown (Anderson, 1992; Jensen, 1998).

Section III: Theories of Intelligence

Modern theories of intelligence attempt to define the construct, describe its structure, relate its amenability to measurement, and explain how it influences behavior. In considering all that, the theories necessarily differ significantly. Five such theories will be examined in order to give the reader an understanding of the present state of the affairs.

The first theory to be described is that of $g$, or the general intelligence factor, so-named by its discoverer Charles Spearman (1904, 1927). Perhaps the major proponent of this theory is the late Arthur Jensen. According to Jensen (1998), and borrowing from Spearman (1904, 1927), intelligence is considered to be a two-factor construct. One factor is general intelligence ($g$), a mental ability which pervades all intellectual functioning. The second is specific ability ($s$). Such abilities as musical pitch and letter memorization are unique and not generally transferable to other situations. Jensen (1969, 1980, 1998) hypothesizes a rather large heritability estimate for $g$, on the order of .80 (meaning that as much as 80 percent of general intelligence is the result of genetic influence). $g$ has been shown oftentimes to be the best predictor of academic achievement (Brody, 1997; Jensen, 1980), occupational success (Arvey, 1986; Brody, 1997; Gottfredson, 1986a, 1986b, 1986c; Hawk, 1986; Hunter, 1986; Jensen, 1986a; Ree & Earles, 1991, 1992; Ree, Earles, & Teachout, 1994), and to be a considerable influence on pro-social behaviors such as law-abidingness, likelihood of voting, and not going on welfare (Herrnstein & Murray, 1994). Some theorists posit that general intelligence underlies, to some extent, the

The reason for the large and pervasive influence of general intelligence has to do with its purported physiological basis in neural efficiency (Deary, 1993; Detterman, 1993; Jensen, 1998; Matarazzo, 1992; Reed & Jensen, 1991). If one brain is able to perceive, process, and transmit information (that is, electrochemical signals) more efficiently than another brain, that first brain is likely to be able to handle more total information, interpret more complex information, and execute behaviors that are both more complicated and adaptive. In psychological terms, those persons with higher levels of $g$ can apprehend experience better, educe relations better, and can educe correlates better than persons with lower levels of $g$ (Jensen, 1998).

A variation on the theory of $g$ is that of Cattell and Horn (see Cattell, 1987; Horn, 1968; Horn & Cattell, 1966). In order to explain older persons’ ability to learn, memorize, and perform on an even or slightly increasing gradient, but their relative inability to maintain high levels of success in dealing with novelty, general intelligence was thought to be composed of two separate entities: $g_c$ (crystallized ability) and $g_f$ (fluid ability). Crystallized ability is malleable, subject to cultural influence, and is able to maintain itself throughout the life span. Fluid ability is more culture free, not as subject to attempts at modification, cannot easily be taught, and seems to decline throughout the life span after hitting its zenith early in the third decade of life. The division of general mental ability into two components, one of which is amenable to educational influence and seems environmentally based, the other of which is more impervious to modification and seems genetically based, accords nicely with behavioral genetic studies (Browne-Miller, 1995; Scarr & McCartney, 1983).

Sternberg (1985) has accepted the work of Spearman (1904, 1927) and Cattell and Horn (1966) and gone a step further. His triarchic theory of intelligence posits not one ($g$), or two ($g_c$ and $g_f$), but three separate factors in mental ability. He accepts the existence of an overall general factor and of the predictive and explanatory validity of fluid and crystallized abilities, but he considers them, on the whole, to be inadequate. That is, there are certain situations where strong analytical skills are not needed. Thus, someone with such skills, though presumably intelligent, probably would not succeed if other skills were called for. Such an example would be one where a creative solution was needed, or where something had to get done “in the real world” as opposed to solving an academic theoretical problem (Sternberg, 1985). The triarchic theory hypothesizes intelligence to have three components: contextual, which involves adaptation, selection, and shaping of one’s environment; experiential, which includes dealing with novelty, automating procedures, and the relationship between those two processes; and, componential, which includes metacomponents, performance components, and knowledge acquisition components. For Sternberg, general intelligence is found in one’s efficient use of metacomponents such as planning and monitoring, since these processes apply across domains. The triarchic approach represents an extension of intelligence theory out of the psychology laboratory and into the “real world” where attributes such as creativity and getting along with
others can matter as much as analytical ability matters (Sternberg, 1999; Sternberg & Williams, 1996).

Another theory which accepts Spearman (1904, 1927) and Horn and Cattell (1966) is Ceci’s (1996) bioecological theory. By his own admission, “the bioecological theory is derivative from the triarchic theory but there are important differences” (p. 210). The bioecological theory, like the triarchic theory, considers context, components, and experience, and both theories allow for a consideration of development. Where they differ is in the importance accorded context. In the bioecological framework context does not just inform information processing and metacomponents, but also perceptions themselves. Additionally, knowledge is treated as a kind of context. Finally, in the triarchic theory the domain-general nature of metacomponents allows them to be considered as part of general intelligence, whereas in the bioecological framework there is no room for a general intelligence since even the metacomponents themselves are hypothesized to be domain-specific.

A final theory that deserves mention only because of the amount of educational reform effort it has spurred is Gardner’s (1983) theory of multiple intelligences. Like Ceci’s (1996) bioecological theory, the theory of multiple intelligences does not posit the existence of a general factor of intelligence, but unlike any of the aforementioned theoretical perspectives Gardner’s (1983) theory considers intelligence to be so broad-based as to include virtually all of human functioning. The theory is based on eight criteria (such as the isolation of the ability when brain damage is incurred, the existence of savants, and an identifiable set of operations) related to neuroscience and psychology that, when combined, leave eight distinct intelligences. The theory has been criticized as lacking a firm (or, indeed, any) experimental or statistical foundation (Brody, 1992; Ceci, 1996; Sternberg, 1990). In fact, one criticism is that the eight intelligences (such as linguistic and bodily-kinesthetic) are nothing more than talents or abilities (Carroll, 1993; see Deese [1993] for a discussion of the differences between abilities and intelligence).

It can be seen in summary that intelligence, beyond basic descriptors, is not easily defined, its structure is not clearly visible, and its essence remains vague. It was for these and other reasons than no less a scholar than Jensen (1998) wrote the following:

My study of these two symposia (the ones in 1921 and 1986 mentioned by Sternberg and Detterman [1986]) and of many other equally serious attempts to define ‘intelligence’ in purely verbal terms has convinced me that psychologists are incapable of reaching a consensus on its definition. . . . Therefore, the term ‘intelligence’ should be discarded altogether in scientific psychology, just as it discarded ‘animal magnetism’ (and) as the science of chemistry discarded ‘phlogiston.’ (p. 48)

Nevertheless, he (and a great many others) maintains its usefulness in everyday life and in research (see Brody, 1992; Browne-Miller, 1995; Ceci, 1996; Eysenck, 1998; Gottfredson, 1997; Herrnstein & Murray, 1994; Locurto, 1991; Neisser, et al., 1996; Sternberg & Detterman, 1986).

Section IV: g and life success
What is the evidence that general mental ability affects life success? And if it does affect it, what is the degree of effect? Leadership can reasonably be considered a type of school, team, business, or military activity. If this is so, then it would follow that the factors which influence success in these areas would imply that they should also influence successful leadership. Furthermore, if one can develop into a successful school, team, business, or military performer, then it too stands to reason that one can develop into a successful leader.

Research conducted over the past few decades demonstrates that general mental ability is by far the single best predictor of occupational success. Ree and Earles (1991) tested the predictive validity of \( g \) and various specific abilities (\( s_1, s_2, s_3, \ldots s_i \)) regarding job-specific training grades for 82 Air Force enlistee jobs. Using the ASVAB, they demonstrated how the several specific abilities added almost nothing to the significant predictive effects of \( g \) on training success. In a following study (Ree & Earles, 1992), they studied the relationship between these predictors and actual job performance. Again, \( g \) was the only significant predictor (\( r = .33 \)) with the various specific abilities adding only .05 to predictive accuracy. Further research by Ree and Earles (Ree, Earles, & Teachout, 1994) confirmed this finding and a final study (Ree, Carretta, & Teachout, 1995) demonstrated the superiority of \( g \) to prior knowledge in predicting success for training in complex tasks. These findings are noteworthy in that \( g \) was essentially found to be the only valid predictor of job training and of job performance. Schmidt, Ones, and Hunter (1992) confirm the aforementioned findings and a later review by Schmidt and Hunter (2004) concludes with the following data- and research-based assertion:

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\text{GMA predicts both occupational level attained and performance within one’s chosen occupation and does so better than any other ability, trait, or disposition and better than job experience. The sizes of these relationships with GMA are also larger than most found in psychological research. Evidence is presented that weighted combinations of specific aptitudes tailored to individual jobs do not predict job performance better than GMA alone. (p. 162)}
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Even when one might suspect that restriction of range might greatly mitigate the effect of intelligence on predicting occupational success, studies indicate that intelligence still manages to maintain its distinction as the preeminent predictor of success. Judge, Klinger, and Simon (2010) note that general mental ability not only positively affects income levels and occupational prestige, but that “the careers of high-GMA individuals ascended more steeply over time than those of low-GMA individuals” (p. 92). High-GMA individuals tended to attain more education, complete more job training (and complete it more successfully), and select more cognitively complex jobs. This is reminiscent of a portion of the title of Ceci and Papierno’s (2005) article: *When the “have-nots” gain but the “haves” gain even more.* Spitz (1999, 2003) demonstrates that educational interventions designed to raise the performance of low SES students do indeed work; but when similar efforts are directed toward similarly poor students with higher \( g \) levels, they gain even more from the interventions. Judge et al. (2010) note that more intelligent individuals take greater advantage of education, training, and job complexity than do less intelligent individuals. This is true even at the highest levels. Park, Lubinski, and Benbow (2008)
show how even among the intellectually gifted, there is still a demonstrable rank ordering of “success” (e.g., number of publications; number of patents) based on a person’s IQ quartile.

Finally, Coumbe, Condly, and Skimmyhorn (in press) document the history of officer testing in the US Army and note that years ago, entrance into the US Military Academy (USMA) was a remarkably difficult task to accomplish. Prospective cadets would often attend, and even graduate from, Ivy League colleges in order to prepare themselves to sit the Academy’s entrance exams (said exams taking 22 hours to complete). USMA utilized the “Thayer Method” of instruction whereby cadets would teach themselves the coursework and then demonstrate their mastery before professors. As the nation’s premier engineering school for many years, and with a 50% attrition rate, it was no small feat to graduate. Of course, graduation did not imply promotion in rank beyond Second Lieutenant as there were promotion exams to sit. It is no wonder then that officers in the US Army could ably plan, strategize, and fight wars as well as segue into the business world and become heads of corporations and railroads.

While it is well known that $g$ affects school performance, there has been a tendency of late to place greater emphasis on factors such as self-efficacy to explain learning and performance. Pajares and Kranzler (1995) both mental ability and self-efficacy affect mathematical problem solving in school. However, in running a path analysis, they were able to demonstrate that mental ability also directly affected self-efficacy itself. Thus, they were able to demonstrate that ability has both a direct and an indirect effect on school performance. Sternberg (1997) maintains that intelligence matters for “lifelong learning and success” because of its ongoing effect on problem identification, data gathering, information processing, and the like. $g$ much more strongly predicts school achievement than does self-efficacy and subject interest (Spinath, Spinath, Harlaar, & Plomin, 2006), and the latest research (see Stankov & Lee, 2017) supports the interactions between self-beliefs such as self-efficacy and intelligence. $g$ has even been shown to be the main personal protective factor when children live in extremely stressful (or toxic) environments (Condly, 2006). It is theorized that high intelligence allows the child to understand the situation, make appropriate adjustments, and develop plans to extricate him- or herself from the situation.

The estimated correlation of $g$ with job performance average .50, ranging from a low of .20 with low complexity jobs to a high of .80 with high complexity jobs (Gottfredson, 1997, 2002). All jobs, no matter the complexity, require learning on the part of the worker. $g$ effectively constrains or affects the rate at which knowledge is gained, how the worker can transfer that knowledge from the classroom to the job site, and how well the worker can adjust to unforeseen or new problems. It also has an indirect effect on work performance in that it affects a worker’s motivation (specifically, the worker’s self-efficacy perceptions). The higher one’s $g$ level, the more a worker knows, the more he or she knows what he or she knows, and the more accurate those self-efficacy perceptions are likely to be. As a result, a high $g$ worker is not only apt to be more skilled, he or she is also better able to maintain levels of interest and self-efficacy necessary to sustain activity and problem solving (especially in the face of complexity or
novelty). These relationships will be further explored in Section VIII and applied to leader development processes and constructs.

Section V: g and leadership

As the reader of this book is no doubt aware, leadership development is not the same as leader development. The former concerns a concept while the latter, a person. Nevertheless, they are obviously related and, as such, leadership development should be discussed. An additional reason for its inclusion here is the fact that much more research has been done with regard to how intelligence and leadership relate than how intelligence relates to leader development; thus, the necessity of this section.

Early studies found a rather strong relationship between general mental ability and leadership. For example, McCuen (1929) compared the intelligence scores of the leaders of 58 different types of organization at Stanford University with the average scores of members in those organizations. He found that the intelligence of leaders was not very much higher than that of group members on average. Of course, since this is Stanford University, there was likely a severe restriction of range problem attenuating the correlation. Stogdill (1948), in his review of personal factors associated with leadership, found that studies reported a very wide variety of correlations between IQ and leadership. These correlations ranged from nearly zero (.06) to nearly perfect (.90); indeed, there were even negative correlations reported. He concluded that most studies showed a positive relationship but that extreme differences between the IQs of leaders and group members typically reduced leader effectiveness. Two years later, Green (1950) was able to differentiate effective and ineffective leaders in terms of their verbal intelligence scores. Using modern effect size statistics (i.e., Cohen’s d), the difference between most effective (n = 27) and least effective (n = 27) on verbal intelligence equaled 0.837. Cohen (1992) offers the convention that at least 80% of a standard deviation’s difference in the scores of two groups is large, or noticeably obvious.

A decade later, Mann (1959) reviewed 69 measures of intelligence (45 questionnaires and objective tests; 24 adjective ratings). Even though he found that 88% of the 196 results in the studies demonstrated a positive relationship between intelligence and leadership, two of the four most frequently used measures of intelligence are hardly measures of intelligence. “The four most frequently used measures of intelligence are: school or college grades, American Council of Education (ACE) Psychological Exam, Cattell’s Sixteen Personality Factor Questionnaire (16 P.F.) Factor B, and total number of responses on the Rorschach” (p. 243). Nevertheless, even with such a collection of measures, the results indicated that verbal intelligence was a better predictor of leadership than was non-verbal tests of memory or mathematical ability. In somewhat more careful research four years later, Ghiselli (1963a, 1963b, 1963c) provided strong evidence of a relationship between intelligence and managerial and leadership success. However, echoing Stogdill (1948), he stated that the “Results…suggest that the relationship between intelligence and managerial success is curvilinear with those individuals earning both low and very high scores being less likely to achieve success in management positions than those with
scores at intermediate levels” (Ghiselli, 1963a, p. 898). However, the relationship between measured intelligence and job level was essentially linear and positive. He hypothesizes that a trait such as high intelligence acts as a gatekeeper for promotion and thereby for success.

These older studies all give evidence of a positive and, more often than not, strong relationship between intelligence and leadership. However, more modern studies are often equivocal. When studying managers and subordinates, for example, it is possible that intelligence differences are simply an artifact of the entire selection process (Jago, 1982). That is, if above average intelligence (whether determined through an actual test or inferred from the possession of a graduate degree) is a criterion for consideration for promotion to management, then it must necessarily be the case that management will ultimately be shown to have higher intelligence than ordinary employees. This objection aside, Lord, De Vader, and Alliger (1986) reanalyzed Mann’s (1959) data and concluded that “the ‘true’ correlations between leadership perceptions and intelligence…were significant…. (I)ntelligence is a key characteristic in predicting leadership perceptions” (p. 407). Two late 20th century studies (Atwater, Dionne, Avolio, Camobreco, & Lau, 1999; Smith & Foti, 1998) continued this new trend in equivocal results. Studying leadership among cadets at the US Military Academy, Atwater et al. (1999) found evidence that intelligence, as measured by the SAT (not an actual intelligence test, but typically used as one in educational and psychological research), predicted who would be more likely to emerge as a leader, but not who would be more effective. Slightly earlier, however, Smith and Foti (1998) did find evidence of a significant positive relationship between intelligence (as measured with the Wonderlic Personnel Test) and both leadership ratings as well as rankings.

More recently, 21st century studies continue this trend in equivocation. In 2000, Mumford, Zaccaro, Johnson, Diana, Gilbert, and Threlfall investigated leadership in the US Army; specifically, identifying what type of person entering the Army was likely to promote to high ranks. Referring to measures of personality, motivation and ability, they found no evidence for a strong direct relationship with leader performance. However, they do note that “patterns of personality, motivation, and ability did exert somewhat stronger effects on skill development and performance” (p. 130). In testing whether tacit knowledge could predict leader effectiveness (in both the military and in corporations), Hedlund, Forsythe, Horvath, Williams, Snook, and Sternberg (2003) found that it did predict effectiveness beyond a test of general verbal ability. However, it is important to note that general verbal ability did correlate with leader effectiveness by itself.

Replicating previous literature reviews such as Stogdill (1948) and Mann (1950), but utilizing modern meta-analytic techniques, Judge, Colbert, and Ilies (2004) meta-analyzed 150 samples from 96 sources. They correct the restriction of range problem with Mann’s (1950 study and reported a correlation of .27 between intelligence and leadership. Correlations of leadership with “paper and pencil” measures of intelligence were lower than were correlations with
perceptual measures. This led them to conclude that “the relationship between intelligence and leadership is considerably lower than previously thought” (p. 542).

Furthering these increasingly weak findings are the studies conducted by Furnham, Crump, and Chamorro-Premuzic (2007); by Gottfried, Gottfried, Reichard, Guering, Oliver, and Riggio (2011); and by Li, Arvey, and Song (2011). The first group used two different intelligence tests and found no distinction among Managers of Managers, Managers, and Non-managers on either test. (Cohen’s $d$ statistics were generally below .20; by convention [see Cohen, 1992], results below .20 are considered to be trivial.) The second group found no effect of IQ on motivation to lead. However, since the population was gifted students, there is the problem of restriction of range. Using the very reliable Wechsler Adult Intelligence Scale-Revised (the WAIS-R), Reichard, Riggio, Guerin, Oliver, Gottfried, and Gottfried (2011) correlated IQ with leadership work duties, work leadership positions, non-work leadership positions, and transformational leadership. The correlations were .16, .14, .28, and .09, respectively. In this study, only the relationship between intelligence and non-work leadership was noteworthy. Finally, the third group sought to determine how strongly general mental ability, self-esteem, and family SES were related to leadership role occupancy and to leader advancement. General mental ability was measured with the Armed Services Vocational Aptitude Battery (ASVAB). Li et al. (2011) found that “the influence of general mental ability on the two leadership variables was not significant for either males or females, but the difference in its effect on the initial status of supervisory scope for males and females was significant” (p. 520). Again, these represent weak findings which contradict research conducted years ago. An excellent summary of present day findings comes from Kanape-Willingshofer and Bergner (2014):

The fact that leadership tasks are of high complexity and that understanding complex issues is a core duty of leaders, suggests that cognitive ability is even more important for leaders compared to non-leaders. Interestingly, empirical research only partly supports this assumption….With regard to the relationship between cognitive ability and leadership it could also be argued that this relationship is a curvilinear one are linear approaches are simply not able to correctly characterize it. Several early studies around Ghiselli (1963) and Stogdill (1948) reported that individuals with either very high or very low IQ-scores had a higher chance for career derailment. In fact, this inverted u-shaped correlation between cognitive ability and leadership might be due to the discrepancy between the leader’s and the follower’s cognitive ability. The more or respectively less intelligent a leader is the more his or her vocational objectives communication strategies, interests, and behavioral patterns will diverge from those of the followers (cf. also Simonton, 1985). (pp. 179-180)

Section VI. g and development

In spite of the thousands of articles and books written on the subject of intelligence, surprisingly little has been written on how intelligence affects human development. One book on
the subject, Anderson’s (1992) *Intelligence and development: A cognitive theory*, contends that intelligence places a constraint on development (in terms of capacity and rate). He further states that “intelligence and development are regarded as merely different ways of talking about the same thing. If we are interested in intelligence, we talk about the steady state structure of cognition; and if we are interested in development, we talk about how this structure changes” (p. 1) (Note: The development to which Anderson refers is more specifically cognitive development rather than social or physical development.) Anderson’s position is that intelligence and development are separate phenomena that influence each other but which “are based on quite different kinds of mechanisms” (p. 3).

Central to nearly all theories of development is the notion of stages; that is, collections of related thoughts, beliefs, processes, and actions which are qualitatively different from the stages which precede them and with come after them. Piaget (Piaget & Cook, 1952), for example, posits the existence of four stages in intellectual development: sensorimotor, preoperational, concrete operational, and formal operational. According to Piaget, understanding conservation is not something that occurs in the first two stages because the child lacks the necessary skills and capacity to engage in such thinking. Kohlberg (1984) applies such stage theorizing to moral development. He identifies six stages of moral reasoning that, again, are qualitatively different from each other. For example, a person operating at Stage 3 (the Good-child orientation) lacks the capability of judging what is moral based on abstract ethical principles of justice and equity (which are Stage 6 moral principles). Unlike Piaget, however Kohlberg is like most developmental theorists in that he also posits the notion of crises that arise and have to be overcome in order to progress from one stage to the next. A final example is Erickson’s (1968) eight psychosocial stages theory. In his theory, individuals develop when they confront a conflict involving ourselves and how we relate to other people. An example is the crisis of Industry versus Inferiority that individuals face in their middle childhood. Here, individuals compare themselves to others and receive either praise or criticism from others relative to their learning and work. Praise tends to build a sense of achievement (Industry) while criticism (or the mere lack of praise) tends to build a sense of inferiority.

Since $g$ typically has been studied as an individual difference phenomenon, most developmental psychologists have paid it little mind. Even Piaget (Piaget & Cook, 1952), writing as he did on intellectual development and cognition, was more concerned with what distinguished children of different ages; he did not compare high- and low-performing children of the same age. This dearth of research on the relationship of intelligence and human development has not served the scientific community very well; in fact, it is something to be regretted. People do differ in terms of general mental ability, and people do have differing developmental trajectories. Since $g$ has been shown to be a factor of singular importance in a great many phenomena (such as academic achievement, accident-proneness, occupational success), it simply stands to reason that it would play a strong role in how, and in how well, people develop. A more detailed examination of the relationship between general mental ability and development could perhaps serve the purpose of this publication most directly. This
assertion is founded on the notion that the capacity for developing the ability to operate at increasing levels of cognitive complexity is potentially linked to an enhanced ability to perform at higher levels of leadership. This too serves as the basis for a more detailed examination of \( g \) and leader development explicitly and guides future research on the topic as discussed below.

Section VII. \( g \) and leader development

This writer agrees with Dalakoura (2010) that we must distinguish between leader and leadership development. In the case of the former, we ask: “What qualities do we need to develop in our leaders?” while in the latter we ask: “What qualities do we need to develop in our organization?” While chemistry and physics have the planetary model of the atom and psychology has Carroll’s (1993) three-stratum model of cognitive abilities, leader development unfortunately has no such generally accepted and comprehensive model. A wide variety of concepts, constructs, processes, systems, and other inputs are identified and asserted to influence leader development. More often than not there is overlap between various models offered (as is not surprising). Avolio and Hannah (2008), for example, while admitting that “a validated framework and theory for leader development does not yet fully exist” (p. 331), identify five factors related to leader development readiness. These are: learning goal orientation, developmental efficacy, self-awareness, leader complexity, and meta-cognitive ability. McCauley, Kanaga, and Lafferty (2010) posit a two-part model (see Figure 1). In their model, the power of developmental experiences are influenced by assessment, challenge, and support. They further specify that the process of leader development is a function of the interaction of the variety of those developmental experiences and of the ability to learn. It is reasonable to combine these two as the efficacy of a model-based system or process dealing with people will depend greatly on their readiness to learn and to develop. (Note: This model has not been subjected to statistical verification utilizing hierarchical linear regression, path analysis, or structural equation modeling (SEM). The model’s veracity is based on reviewing the literature, distilling concepts, and on professional experience. This is not to cast aspersions at the model; it is merely to make clear that this is not a scientifically tested model.)

Figure 1 Leader Development Model
McCauley et al. (2010) are quite clear that “developmental experiences and the ability to learn have a direct impact on each other” (p. 5). What is also clear from this model, however, is that Ability to learn has not only a direct effect upon Leader development but also an indirect one (through those Developmental experiences). Conversely, the model states that Developmental experiences directly influence Leader development and indirectly influence it through Ability to learn. Again, while there is no direct experimental scientific evidence to support the veracity of the model and its relationships, the remaining parts of this submission will reference the research literature which supports or casts doubts upon these claims.

Little direct and specific research has been done examining how general mental ability affects leader development. What little research has been done all seems to have been conducted in the 21st century. Boyce, Zaccaro, and Wisecarver (2010) ran a structural equation model analysis on the propensity for self-development of leadership attributes. The path between cognitive ability (as measured by the Wonderlic Personnel Test) and two types of skill (self-directed learning competencies and self-regulatory skills) was found to be an insignificant path in the model. However, these two types of skill were not actually measured; instead, the researchers used Likert scale items to measure perceptions of ability or self-efficacy. This means that it might have been possible to show a significant path had these skills been properly measured. Three years earlier, Foti and Hauenstein (2007) examined the effect a variety of cognitive factors (e.g., intelligence, dominance, general self-efficacy, and self-monitoring) had on leader emergence and leader effectiveness. They reported that “(p)ersons scoring high on the set of individual difference variables emerged as leaders, were promoted to leadership positions, and were rated by their superiors as effective leaders” (p. 347).

Two more studies realized positive effects. Blair, Gorman, Helland, and Delise (2014) Using the Watson-Glaser Critical Thinking Appraisal to measure intelligence, and after controlling for industry type, they found support for their two hypotheses (H1—intelligence positively related to goal quality; H2—intelligence positively related to the correspondence between feedback and goals). More substantial support for the relationship between intelligence and leader development comes from Daly, Egan, and O’Reilly (2015). Using a cohort of nearly 17,000 individuals in the United Kingdom, the cohort was given the British Ability Scales test at age 10. Results were as follows:

On average a 1 standard deviation increase in cognitive ability predicted a 6.2 percentage point higher probability of leadership role occupancy. In Study 1, adjusted models showed that 37.3% of high cognitive ability children (+1 SD) occupied leadership positions compared to 25.4% of low cognitive ability children (−1 SD) children and this gap was even more pronounced in Study 2 (27.8% vs. 15.1%). Cognitive ability showed a graded association with the number of employees supervised in both studies and educational attainment. (p. 323)

However, just as there was equivocation in the results of studies on g and leadership, so too here not all studies agreed. For example, Guerin, Oliver, Gottfried, Gottfried, Reichard, and Riggio (2011) found that “(a)dolescent IQ had neither a direct nor an indirect relationship with
adult leadership potential, nor did it interact with extraversion in predicting adult leadership potential” (p. 482). Thus, even in the far smaller field of $g$ & leader development studies, there is no consensus on findings.

Section VIII. Correlates of $g$ and leadership

The relationship between $g$ and leadership has a long but only somewhat deep history; $g$ and leader development, on the other hand, has only a recent and thin history. But there is good news: Correlates of $g$ (such as learning, knowledge, and reflection) have been studied much more frequently as personal characteristics of leaders and as essential elements in leadership practice. These studies are herein reviewed.

A great many studies refer to skills that are asserted to be essential for good leaders to possess and utilize. Skills are a form of procedural knowledge (Anderson & Lebiere, 1998; Gagné, Yekovich, & Yekovich, 1993) and are best defined as “knowing how” (in contrast to its companion form, declarative knowledge, which is knowledge that something is the case). Through deliberate practice one can completely automate the execution of the skills one possesses so that they operate cleanly, efficiently, quickly, and unconsciously (Ericsson & Charness, 1994). Campbell and Dardis (2004), for example, explain the US Army’s “Be, Know, Do” model of leadership. The Know component is composed of Interpersonal Skills, Conceptual Skills, and Technical Skills. It is clear that these would all be strongly affected by general mental ability.

The Spring 2000 edition of The Leadership Quarterly (see Yammarino, 2000) is devoted to the topic of leadership skills. In this issue Connelly, Gilbert, Zaccaro, Threlfall, Marks, and Mumford (2000) give a very detailed study examining relationships among complex problem-solving skills, social judgment skills, and leader knowledge with respect to leader achievement and quality of solutions to ill-defined leadership problems. Marshall-Mies, Fleishman, Martin, Zaccaro, Baughman, and McGee (2000) sought to identify those skills to be measured cognitively and metacognitively in order to predict leadership potential. The skills they identified are: General problem solving; planning and implementation; solution construction; solution evaluation; social judgement; metacognitive assessment. These skills vary in terms of their content and methods of execution, but they are are all obviously strongly affected by $g$. Although causality was not determined, Mumford, Marks, Connelly, Zaccaro, and Reiter-Palmon (2000) found that as they tested increasingly higher ranked officers—there were six levels from Second Lieutenant to First Lieutenant to Captain to Major to Lieutenant Colonel to Colonel—problem-solving, systems, and social skills were all increasingly superior. They concluded that “(l)eaders, no matter how gifted, initially enter organizations as novices. Thus, they lack basic concepts that provide them with an understanding of the work, organizational contexts, and leadership roles” (p. 89). Zaccaro, Mumford, Connelly, Marks, and Gilbert (2000) give details about the development of the instruments used in the aforementioned analysis. This research gives clear support for two related notions. One is that $g$ plays a role in promotion. Since skill acquisition and development is primarily mental, it is reasonable to conclude that higher levels of $g$ will
assist any one person in mastering those skills. And such a person would thereby be more likely to be promoted as he or she shows himself or herself to be more expert and more professional. The other related notion is that skills, even complex ones, are indeed learnable; though practice and support individuals can learn, develop, and master skills and knowledge.

Other researchers use a term related to skill: ability. Within psychology skill and ability are readily differentiated, but not all leadership researchers are psychologists. Ability is typically imagined or assumed to be more fundamental to a person than a skill is and also somewhat less amenable to intervention. This writer acknowledges the use of the term and offers this brief summary review. Campbell and Dardis (2004), in their aforementioned “Be, Know, Do” model, identifies intelligence as fundamental mental attribute (one of seven such) of their model. They define intelligence as “the ability to think, learn, and reflect, and then to apply what has been learned” (p. 29). Pech (2003) lists nearly 50 abilities (e.g., assessing, guiding, analyzing, perceiving) as part of the MAPA leadership architecture. Such abilities as these would likely be strongly influenced by general mental ability and thus show a positive relationship between g and leadership. Among the factors which Murphy and Johnson (2011) identify as essential for engaging in leadership tasks are the ability to grasp abstractions and social ideals. And on a related note, Vaculik, Prochazka, and Smutny (2014) wrote of “competencies” rather an abilities; however, the results are what would be expected. Task-related competencies, as opposed to people- and self-related competencies, were correlated with group performance, leadership self-efficacy, and perceived leadership effectiveness. All three were correlated with leadership emergence.

Some researchers speak of leadership and leader development in self-development terms. That is, rather than emphasize what training can deliver to the person, these theorists suggest that what matters more is what the person does for him- or herself. Day (2001), for example, states that “within this tradition, development is thought to occur primarily through training individual, primarily intrapersonal, skills and abilities” (p. 583). But he also emphasizes the “overarching development strategy the overarching development strategy is to build the intrapersonal competence needed to form an accurate model of oneself (Gardner, 1993, p. 9), to engage in healthy attitude and identity development (Hall & Seibert, 1992), and to use that self-model to perform effectively in any number of organizational roles” (p. 584). That self-based models of leader development would be influenced by general mental ability is rather clear given this quotation from Gardner, Avolio, Luthans, May, and Walumbwa (2005): “A key factor contributing to the development of authentic leadership is the self-awareness or personal insight of the leader…. (T)he second fundamental component of authentic leadership development is self-regulation” (p. 347).

Learning seems to get top billing on the list of desirable or essential skills, traits, characteristics, abilities, or competencies for leader development. For example, Popper (2005; see also Popper & Maysless, 2007) asserts that “three developmental psychological principles are essential for leaders’ development, i.e. experiential learning, vicarious learning, and the
suitability of certain developmental aspects to relevant critical periods” (p. 62). Here, learning appears twice; the strong relationship between \( g \) and learning need not be reasserted. And Marcy and Mumford (2010) demonstrated how training in causal analysis greatly improved leader performance, particularly on increasingly complex tasks. Although not supportive of the practice, Reichard and Johnson (2011) note that “(I) leader development usually takes the form of formal training, job rotation, or off-site workshops where the instructor or coordinator of the program determines what and how the leader will learn” (p. 34). Here too one can infer that \( g \) would play a strong role in leader development since \( g \) affects the efficacy of training, job rotations, and workshops.

Whether leaders develop their skills, knowledge bases, competencies, abilities, or continually learn how to deal with complexity, the results are unambiguous. Individuals who are more skilled, have wider and deeper knowledge bases, are more competent, able, and who learn efficiently tend to make better workers in general and leaders in particular. That \( g \) would play a role in this is most certainly to be expected.

Section IX: Implications for instruction at USMA and for US Army training and education

Given the reviewed literature, it might seem almost pointless to consider \( g \) when developing leaders in training or education settings. One could argue, after all, that \( g \) is relatively fixed, resistant to the effects of interventions, and the Army has must simply deal with the personnel it has on hand. Of course, this attitude reflects the continuing misperception of intelligence being about capacity rather than about rate. It bears repeating: Except for the severely mentally retarded, anyone can learn anything if they are given enough time and support. \( g \) simply reflects the ability of the individual to succeed in this task in less time and/or without what most would consider “necessary” support. In short, Army personnel in general, and USMA cadets in particular, are capable of learning how be become leaders of character.

In the typical classroom on a typical day, the instructor introduces new material; that is, material which is new to the students and which they must learn (presumably for success in life, but immediately for purposes of passing a test). “Bright” students will learn the material quickly; more average students will require more time and/or support. Additionally, and most importantly for USMA and the US Army, the brighter students will be more likely to transfer that new knowledge to situations which qualitatively differ from the situations presented in the learning environment. For example, at USMA, cadets are introduced to the topic of counseling subordinates in a single lesson in PL100 (General Psychology for Leaders). They are assigned textbook pages to read, and typically engage in a mock counseling session in class. While it is not possible to develop expertise in a single lesson, at least cadets are made aware of the importance of counseling subordinates and are exposed to operational principles which, when utilized, effect a successful counseling session.

Do they use this outside of class? The Department of Behavioral Sciences & Leadership does not track cadets in terms of how well or poorly they apply PL100 principles over time, but a reasonable hypothesis would be that, the higher a cadet’s general mental ability, the more likely
he is to remember what he has learned, and the more likely he is to transfer it to situations which
do not resemble the classroom setting. There is little the Academy can do to “fix” this result, but
it needn’t try. Virtually every class at USMA—indeed, virtually every class in the nation’s
colleges and universities—is ability variegated; most students are “average” or fairly close to the
class’s mean. As such, teachers teach to the middle. Additional support can (and should) be
offered for the less able students (note—less able does not necessarily imply low g; one can be
temporarily less able than one’s peers due to being out ill for an extended period of time and,
therefore, missing a lot of material) while also utilizing techniques such as the use of rhetorical
questions to raise the level of discussion and learning (as long as students understand that such
questions and answers are not part of the testable portion of the class). This format benefits the
high-g students who need more than that basics, but it also benefits average students in that they
unwittingly participate in implicit learning. Seger (1994) defines implicit learning as
“nonepisodic learning of complex information in an incidental manner, without awareness of
what has been learned” (p. 163). In other words, they learn almost in spite of themselves; they
learn by virtue of their being there.

Efforts to teach transfer have not met with great success (see, for example, Butterfield
and Nelson, 1989; and Halpern, 1998). This is because, while models can be created and
principles identified, the issue of general mental abilaty still remains. People with high g will
simply be more likely to spontaneously tranfer knowledge from one domain to another as
compared to more average individuals. The tendency for knowledge to remain embedded in the
domain in which it was learned is difficult to overcome. An implication of all this is that the best
way to foster the general use of leadership principles by cadets (and the Army’s personnel as
they progress in rank) is to continually teach and require the use of the principles regardless of
the course or learning environment. This is akin to the use of the 26 letters of the English
alphabet in chemistry, physics, philosophy, etc. “And” maintains its meaning across domains and
courses while ħ (h/2π, or the quantization of angular momentum) does not.

Section X: Conclusions and future research

Since leader development is the newer field (compared to leadership development), the
field can advance by incorporating the rich research history of general mental ability with efforts
at understanding, explaining, and influencing leader development. The importance of g has been
well documented in this submission, but the following from Jensen (1998) should suffice to allay
any potential objections to its singular influence on a wide variety of outcomes.

The g factor (and highly g-loaded test scores, such as the IQ) shows a more far-reaching
and universal practical validity than any other coherent psychological construct yet
discovered. It predicts performance to some degree in every kind of behavior that calls
for learning, decision, and judgment. Its validity is an increasing monotonic function of
the level of cognitive complexity in the predicted criterion. Even at moderate levels of
complexity of the criterion to be predicted, g is the sine qua non of test validity. The
removal of g (by statistical regression) from any psychometric test or battery, leaving
only group factors and specificity, absolutely destroys their practical validity when they are used in a population that ranges widely in general ability.

The validity of \( g \) is most conspicuous in scholastic performance, not because \( g \)-loaded tests measure specifically what is taught in school, but because \( g \) is intrinsic to learning novel material, grasping concepts, distinctions, and meanings. The pupil’s most crucial tool for scholastic learning beyond the primary grades—reading comprehension—is probably the most highly \( g \)-loaded attainment in the course of elementary education.

In the world of work, \( g \) is the main cognitive correlate and best single predictor of success in job training and job performance. Its validity is not nullified or replaced by formal education (independent of \( g \)), nor is it decreased by increasing experience on the job.

Although \( g \) has ubiquitous validity as a predictor of job performance, tests that tap other ability factors in addition to \( g \) may improve the predictive ability for certain types of jobs—tests of special ability for mechanical jobs and tests of speed and accuracy for clerical and secretarial jobs.

Meta-analyses of hundreds of test validation studies have shown that the validity of a highly \( g \)-loaded test with demonstrated validity for a particular job in a particular organizational setting is generalizable to virtually all other jobs and settings, especially within broad job categories.

The \( g \) factor is also reflected in many broad social outcomes. Many social behavior problems, including dropping out of school, chronic welfare status, illegitimacy, child neglect, poverty, accident proneness, delinquency, and crime, are negatively correlated with \( g \) or IQ independently of social class of origin. These social pathologies have an inverse monotonic relation to IQ level in the population, and show, on average, nearly five times the percentage of occurrence in the lowest quartile (IQ below 90) of the total distribution of IQ as in the highest quartile (IQ above 110). (pp. 270-271

In view of this summary, and in light of the relative youth of the study of leader development, the following recommendations are proffered:

1. **Identify and specify the key components of a model of leader development.** Before details emerge of just how general mental ability relates to the development of leaders, it that developmental process, though likely complicated, needs to be represented in a comprehensive model. All sciences use models to explain how things work (e.g., the planetary model of the atom in chemistry; a globe in geography). The science of development, specifically leader development, may be quite nascent, and it may also be quite complicated due to the fact that it pertains to humans and their thoughts, behaviors,
and social interactions, but it nevertheless behooves researchers in the field to agree their general position.

2. **Include measures of mental ability in studies of leader development.** The importance of g cannot be ignored. The literature reviewed in this submission gives ample evidence of its general importance in life and its likely importance in the development of leaders. Instruments such as IQ tests abound; researchers can use data that comes from their use as they develop their models and study the various interactions among variables.

3. **Perform SEM analyses in order to determine causality, directionality, and the strength of direct and indirect influences of g on leader development.** SEM represents a grand leap forward for the social sciences. For the first time, researchers have in hand a tool that merges statistics and measurement (see, for example, Loehlin, 2004). It allows for the determination of causality in the first and corrects for error in the second. Development is a complicated, iterative, recursive process that involves multiple variables interacting directly, indirectly, and that utilizes various feedback loops. SEM, more so than perhaps any other statistical tool available, can help shed light on just how the variables and factors purported to be involved in the development of leaders actually transpires.

4. **Test interactions of the many variables which have been shown, or purported, to influence leader development.** This is a recommendation for a finer grained analysis (which may or may not involve the use of SEM). An advantage of this more limited analysis is that it will not necessitate the use of large sample sizes that SEM does. Multiple regressions, simple linear regressions, correspondence analyses; these are some techniques that can prove beneficial to our understanding of how leaders develop, and what develops them, beyond simple correlations and descriptive statistics.

5. **Apply findings and principles from the literature on the development of advanced expertise to leader development.** Given the rather strong genetic basis of g, some people are likely to be put off and conclude that leaders are more discovered than made. However, the extensive literature on human expertise, certainly from the 1980s, gives great cause for hope (see, for example, Ericsson & Smith, 1991). There is an abundance of evidence that people of all intellectual stripes can become expert in any given domain by committing to deliberate practice and when receiving corrective feedback. General mental ability certainly plays a role in this endeavor (see Detterman, 2014, on the special edition of *Intelligence*), but leadership is a domain like tennis, chess, or the culinary arts. The degree to which g constrains how easily one develops as a leader, or how one transfers knowledge and skills from one situation calling for leadership to another, remain good questions for ongoing research. But the vast literature on expertise development, indeed on training and education, gives one reason for hope that even basic research can have positive real world effects in developing competent and effective leaders.
References


