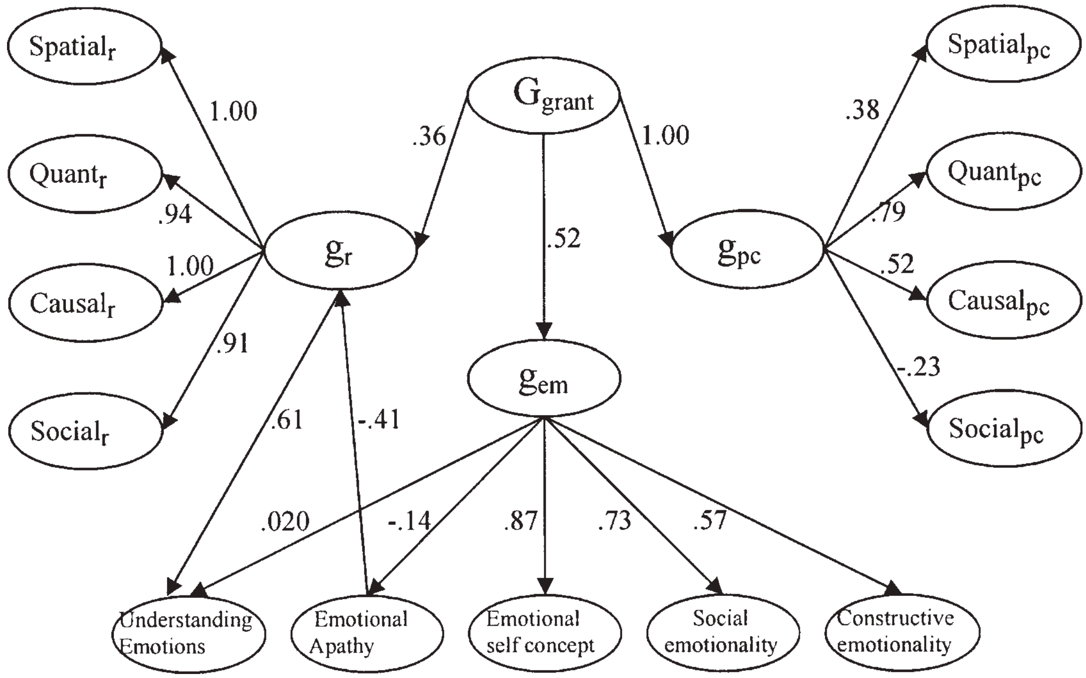

Figure 2 (Demetriou). The best-fitting model to the performance and self-representation attained at the batteries of the second study. *Note 1:* χ^2 (305) = 486.824, CFI = .918, $p < .001$, RMSEA = .049, and 90% confidence interval = .041 − .057 *Note 2:* All but the $\mathbf{g_{em}}$ – *Understanding emotions* relations are significant.
[Glossary: **em** stands for emotional; for the other symbols, see Fig. 1 caption.]

laden situations (e.g., "When unfairly scolded, I prefer to talk with others and show them that they are wrong"), and emotional apathy (e.g., "I am indifferent to praise").

Figure 2 shows the best-fitting model to the scores generated by these batteries. There was a first-order factor for each domain of reasoning, a first-order factor for self-representation about these domains, and a first-order factor about the various emotional understanding and self-representation factors. Each set of these three types of factors was regressed on a second-order factor, standing for general reasoning ($\mathbf{g_r}$), general perceived competence ($\mathbf{g_{pc}}$), and emotional processes ($\mathbf{g_{em}}$). Finally, these three second-order factors were regressed on $\mathbf{G_{grand}}$.

Attention is drawn to the relations between the second-order factors and G_{grand}. They are .36, 1.0, and .52 for the $\mathbf{g_r}$, $\mathbf{g_{pc}}$, and $\mathbf{g_{em}}$, respectively. Obviously, this factor, due to the dominance of self-representation items, is highly loaded by self-awareness. It is noteworthy that its relation with $\mathbf{g_r}$ and $\mathbf{g_{em}}$ is significant and in the same range, indicating that self-awareness is a powerful dimension of general intelligence that operates as a liaison between its inferential and its dynamic dimensions. Attention is also drawn to two interesting relations. On the one hand, understanding emotions was strongly connected to $\mathbf{g_r}$ (.61) but negligibly to $\mathbf{g_{em}}$ (.02). On the other hand, emotional apathy was substantially and negatively related with $\mathbf{g_r}$ (−.41). Therefore, the processing of emotions involves a strong inferential component, but, at the same time, inferential processes require emotional involvement to function.

Both models were retested after partialling out the effect of age and found to still fit well. Therefore, the architecture they revealed is genuine to the organization of the various processes rather than the result of possible developmental differences between tasks. This architecture substantiates Blair's claims that psychometric *g* and fluid cognition are not identical and that there are close relations between cognitive and emotional processes. Self-awareness is crucial in sustaining these relations. Therefore, the functional architecture of cognitive and emotional processes uncovered by structural modelling concurs with their organization as suggested by modern research in neuroscience.

Towards a theory of intelligence beyond *g*

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Abstract: Brain physiology and IQ gains over time both show that various cognitive skills, such as on-the-spot problem solving and arithmetic reasoning, are functionally independent, despite being bundled up in the correlational matrix called *g*. We need a theory of intelligence that treats the physiology and sociology of intelligence as having integrity equal to the psychology of individual differences.

Take the ability to solve problems on the spot without a previously learned method as tested by Raven's or Similarities. When normal people are ranked against one another at a given place and time, those who do better than average on this kind of problem-solving tend to do better on a wide range of cognitive tasks. Thus, this cognitive skill is positively correlated with cognitive tasks, predicts performance on them, and earns the label gF (fluid general factor). However, when society sets helter-skelter priorities over time – say, emphasizes on-the-spot problem solving and neglects arithmetic reasoning (taxpayers are too silly to pay for good math teachers) – the correlation between this kind of problem solving and other cognitive tasks simply unravels (Flynn 2003). Its predictive potency fades away and, since that is the essence of gF, it should have a new name. I suggest Fpsa (fluid problem-solving ability).

The only thing that could prevent society from unraveling the correlational matrix would be brain physiology: a human brain so structured that no single cognitive ability could be enhanced without enhancing all of them. As Blair triumphantly shows, the brain is not like that. When we turn to abnormal brains – those affected by trauma, phenylketonuria, or unusual stress – we find the following: Just as society can pick and choose which mental abilities it wishes to improve, so the brain is sufficiently decentralized that it can pick and choose. Its damaged areas can veto a normal level of Fpsa while, at the same time, its undamaged areas can foster normal levels of other cognitive abilities.

Uncorrelated cognitive abilities are significant despite not being bundled up in *g*. People today are better at lateral thinking on the job and better at chess, and more acute in on-the-spot assessment of the quality of political debate, than they used to be (Flynn, in press). Brain-damaged children can keep up at school despite below-average Fpsa. If the theory of intelligence is to accommodate uncorrelated abilities, it must transcend *g*. What form would such a theory of intelligence take?

It would have three levels: (1) The B (brain) level, where brain physiology shows how much coordination and how much autonomy functional mental abilities are likely to manifest – shows what degrees and kinds of problem-solving abilities are likely for both normal and abnormal brains. (2) The ID (individual differences) level, where we assess how cognitive abilities vary from one person to another in a homogeneous social setting, and which shows the extent to which abilities are inter-correlated and predictive of one another in that context. (3) The S (social) level, where evolving and diverse social priorities over time free specific mental abilities from the strictures of *g* (within the limits that the brain allows) and shows them swimming freely from one another and having important consequences. It shows, for example, why America, despite a huge increase in Fpsa, has to import foreigners to do its mathematics.

An affection for acronyms suggests a label like the BIDS theory of intelligence. Its focus would be making sense of how various levels are interrelated. At times, one level may show that what happens on another is surprising enough to require explanation. For example, brain physiology (B level) suggests that Fpsa is functionally independent of other mental abilities. Yet, when we measure individual differences (ID level), *g* emerges – which is to say individuals who beat the rest of us on one cognitive skill, often outdo us on most cognitive skills. So we have to go back to the brain. Even though different areas are autonomous in the sense that one can function when another is damaged, and in the sense that they can be differentially developed by social change, there must be some overall qualitative factor (the synapses?) – something that makes one normal brain function better on virtually all kinds of problem-solving than another.

At other times, one level may even imply that what is happening on another level is impossible. For example, Jensen (1998, pp. 445–58) analyzed twin studies on the ID (individual differences) level that dramatized the weakness of environment. Indeed, environment appeared so weak that environmental change could not possibly cause huge cognitive gains over a short time – which seemed to imply that IQ gains simply had to have a genetic origin (hybrid vigor) or be spurious. At this point, the Dickens-Flynn model restored coherence to the system by showing that the primacy of genes over environment in individual life history is fully compatible with huge environmental effects as society evolves (Dickens & Flynn 2001a; 2001b).

The *g* theory of intelligence is limited because it views the physiological and sociological levels through its own spectacles. It asks: What elementary cognitive tasks correlate with *g*; what cognitive trends over time correlate with *g* or at least are factor invariant (Wicherts et al. 2004); and so forth. It is as though the physics of moving objects within the earth's gravitational sphere had demanded that astronomy and subatomic physics confine themselves to its model, whereas the way forward was more comprehensive models within which Galileo's equations found their proper place.

The BIDS theory has already paid dividends. Schools teach young children matrices under the delusion that matrice skills and arithmetic reasoning are functionally related. IQ gains over time on the Wechsler Intelligence Scale for Children (WISC) subtests show that the first skill can be greatly augmented with no effect on the second. The relationship is actually correlational. It is as though we observed that good high jumpers tend to be better-than-average sprinters at any given time – and drew the conclusion that the way to improve high-jump performance was to practice sprinting. We would quickly discover that no high jumper hurtles toward the bar at maximum speed; rather, one gathers the moderate amount of momentum compatible with timing the jump. The correlation between high-jump excellence and sprinting excellence does not signal a functional relationship between the two skills.

A symposium should be convened so that Blair and like-minded thinkers and *g*-men (because *g* is still important on its proper level) can get together and look for a breakthrough in the theory of intelligence. We live in exciting times.

Early intervention and the growth of children's fluid intelligence: A cognitive developmental perspective

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Abstract: From the stance of cognitive developmental theories, claims that general *g* is an entity of the mind are compatible with notions about domain-general development and age-invariant individual differences. Whether executive function is equated with general *g* or fluid *g*, research into the mechanisms by which development occurs is essential to elucidate the kinds of environmental inputs that engender effective intervention.

The debate surrounding the existence of general *g*, and its relation to fluid *g*, bears on the efforts of cognitive developmental psychologists to distinguish between general and specific aspects of children's intellectual growth (Case et al. 2001; Lautrey 2002). Domain-general approaches to development aim to identify cognitive skills that exert a pervasive influence on behavior, even in the presence of specialized abilities with which they interact. In contrast, domain-specific approaches offer a compartmentalized view of the mind by focusing exclusively on the operation of functionally independent modules.

A variety of domain-general accounts exist, some of which have advocated components of executive function, such as working memory, as prime candidates for explaining broad, age-dependent gains in intellectual ability (e.g., Case 1992). Despite their physiological localization in the frontal regions of the brain, executive functions could thus constitute a driving force in cognitive development that has ramifications for all mental activities. Recent years have seen major advances in the understanding of executive function and its role in the emergence of consciousness (Zelazo 2004), agency (Russell 1999), and self-regulation (Carlson 2003). Not only does executive function undergo marked improvements as children grow older, the distinction between "hot" and "cool" executive function seems well placed to provide new insights into the development of social cognition and behavior (Zelazo et al. 2005).

If executive function is equated instead with fluid *g*, then general *g* might correspond with some other aspect of development such as global processing speed (e.g., Kail 1991) or, alternatively, a dimension of intelligence that is not related to development at all. As an example of the latter approach, the minimal cognitive architecture model of intelligence and development (Anderson 2001) views intelligent behavior as a product of both age-invariant and developmental mechanisms. The model assumes that age-invariant mechanisms are responsible for individual differences in intellectual ability within a particular developmental level and are determined mainly by heredity. In contrast, it sees developmental mechanisms as involving the maturation of dedicated information-processing