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Assessment in educational settings thus far has centred on self-report style questionnaires and the assessor’s own observations. While direct neurological testing of personality factors is not yet available, advances in our understanding of brain mechanisms underlying various personality and learning factors has given us hope that more refined knowledge of brain systems will lead to this more direct form of testing in the not too distant future. This holds the potential of a more reliable and valid assessment, particularly with children who are uniquely susceptible to test situation characteristics, biases and language development issues. Before this can occur a thorough understanding of personality constructs, from well-developed pen-and-paper assessment, must take place. This paper aims to explore what must be done to clarify the relationship of the Big-Five personality factors, and self-concept in relation to well-being for such findings to translate to useful neuro-assessment tools in school settings. It is suggested that professionals in schools will benefit most from dual assessment of both brain function and self-report measures to get the best possible data for use with students.

Test bias and test taking characteristics are problems that are present in all areas of psychology assessment. This is especially problematic when working with children in educational settings as children are uniquely susceptible to many areas of test bias and test taking characteristics, especially when one considers language development issues arising from general developmental delays, age appropriate language comprehension issues and language issues with children from non-English speaking backgrounds. With the increase of technology new opportunities for measurement that are biologically and neurologically based have become a legitimate possibility. The long-term goal of this is to develop measures for important constructs that can transcend the problems of pen-and-paper tests that plague research in educational and general psychological research by providing direct assessment of the construct of interest via more implicit tests of the phenomena of interest. Further, recent research has shown that neurological based assessment can provide data on brain activation while the participant is interacting in social encounters or real-world challenges (Eisenberger, Lieberman & Williams, 2003).

Many now believe that biological measures of many psychological phenomena has begun, such as Matarazzo (1992, p.1007) who has predicted the “use of new generations of paper-and-pencil inventories, as well as biological measures for assessing differences in interests, attitudes, personality styles, and predispositions”. It is suggested that more accurate understandings of constructs such as self-concept, the Big-Five personality traits and well-being will, through biological and neurological measures and better psychometrics tests, allow a more thorough understanding of how these constructs affect individual differences in educational settings. Advances have already been made in
testing intelligence in cognitive neuroscience that has provided the impetus for this paper (for a review see Matarazzo, 1992). It is hoped that similar advances will be made with other constructs that are important to educational psychology such as self-concept, the Big-Five personality traits and well-being. However, before this can occur a thorough understanding of the way these three concepts interact, from well-structured and validated pen-and-paper measures, is needed. Not only are these constructs important for academic aspects of the educational setting, especially academic self-concept, but they are also significant to non-academic influences that are important in educational settings.

Neurological advances in the study of personality

Recent advances in technology have provided some exciting opportunities to explore areas of human experience from a different perspective, namely biological or neurological. However, despite these advantages, several limitations exist. Namely, that current technology still does not have the specificity required to explore the functional units across time that is required for attributing complex behaviour to brain function (Matarazzo, 1992). Further, complex phenomena are likely to be multimodal integrating information from several areas and brain structures are likely to be activated for many different behaviours with differential activation for each behaviour (Starter, Bertson & Cacioppo, 1996). This leads to the need for not only localizing an area in the brain that is associated with a construct but knowledge of the complex nature of interaction between brain areas and the patterns of activation involving all brain areas associated with this construct before a thorough understanding of the neurological substructure of complex areas of human experience can be understood and evaluated. Due to this complexity it is often advantageous to begin with cognitive indicator variables that are known to have strong links to neurological functioning such as inspection time or reaction time when exploring complex constructs before progression to neurological imagery. It is suggested that exploration of self-concept in particular should follow this progression given it maintains both an evaluative component (I am good at physical activity) and an affective component (I like physical activity) (Marsh, Traytwein, Ludtke & Baumert, in press).

Despite these complexities considerable progress has been made in relating brain functions and localization to some of the more base personality constructs. For instance, research into a neurological measure of impulsiveness has shown some positive results (Fallgatter & Herrmann, 2000). Some evidence for the neuro-chemical structure of extraversion has begun to emerge. This research has suggested that introversion is associated with left-lateralized activity in the putamen and thus extraversion is suggested to be somewhat reliant on dopaminergic circuits (Fischer, Wik & Fredrikson, 1997). Research on a patient whose semantic and episodic memory was severely affected suggested that ratings of self-specific personality traits were unaffected and not based on social desirability. It would seem that knowledge of one’s personality makeup is not reliant on brain structures associated with memory. Interestingly autobiographical memory was affected in this patient and his ratings of the personality of close others was also affected (Klein, Rozendal & Cosmides, 2002).
This suggests firstly that ratings of one’s personality are biologically distinct from ratings of others’ personality and that ratings of one’s own personality are not reliant on episodic, semantic or autobiographical memory systems in the brain. This is yet to be tested in non-clinical samples in relation to the Big-Five and multi-dimensional self-concept. Reaction time task and other cognitive measures have been found to be useful in diagnosing neurological degenerative diseases such as Alzheimer’s and thus provide a useful first step in exploring the neurological basis of personality constructs (Zappoli, Versari, Arnetoli & Paganini, 1990). However, before such testing can occur, a tougher understanding of important personality constructs (Big-Five, self-concept and subjective well-being) and, more importantly, the relationship between them needs to be established.

**Self-concept**

*A substantial amount of information processed by an individual (some might even argue the majority of information) is information about the self* (Markus, 1982, p.50).

It is this central importance of the self and self-concept that has led many influential psychologists and psychology movements to generate theories of its formation, constituents and maintenance. William James (1963/1890) was the first to develop a theory of the self, in which the self-concept was considered to be multi-dimensional, constituted by a material self, a social self, a spiritual self and pure ego. From these meta-theories of the self came specific theories of self-concept, its constituents, construction and definition. These theories tended to focus on global evaluations of the self such as self-esteem (see Rosenberg, 1979). One such theorist was Coopersmith (1967, p.6), who suggested that children either “make little distinction about their worthiness in different areas of experience or, if such distinctions are made, they are made within the context of the over-all, general appraisal of worthiness that the children have already made”. It is argued here that while this reduces much of the complexity about self-judgments, it substantially reduces power in uncovering information that can be gained from the domain specific components of self-concept.

In the 1970s there was a move towards integrating self-concept research. Wylie (1979, p.ix) suggested that there needed to be “a sobering view of theoretical and methodological problems which must be taken into account before generalizing about self-concept variables on the basis of past research”. One such move towards the goal of integration came from Shavelson, Hubner and Stanton (1976). Shavelson et al. aimed to provide an integrative definition and a preliminary theory for future evaluation. Their definition of self-concept suggested that the construct is multifaceted and hierarchical. They argued against the distinction of self-concept as descriptive and self-esteem as evaluative contending that both are evaluative (Shavelson et al., 1976). It is noted that this theoretical perspective suggests that terms such as self-esteem, global self-concept and general self-concept are synonymous and thus they are considered so within this paper. Shavelson et al.’s theoretical framework included a global component at the apex that pertains to judgments about the self that have no reference to specific domains. The next stratum has an academic self-concept and several non-academic components (social, emotional, physical self-concepts). These refer to evaluations about the self that concern
a particular domain. Subsequently the hierarchy becomes more and more differentiated, such as academic self-concept that is composed of subject specific domains. It was hypothesized that self-concept would become more differentiated with age. Further it is important to note that Shavelson et al. (1976) suggested that self-concept was not just socially formed as was considered by Cooley and Mead but internally and experientially as well.

Following Shavelson et al. (1976) paper substantial research has taken place evaluating the theoretical propositions that this paper put forward. Early research focused heavily on the academic self-concept, which resulted in the finding that the correlations between math and verbal (English) self-concepts were minor. This lead to a revision of the Shavelson et al. (1976) model where academic self-concept was represented by two second order factors representing verbal and math self-concepts (Marsh & Hattie, 1996). Research also suggests that self-concept becomes more differentiated with age at least up to adolescence as predicted by Shavelson et al. (Byrne & Worth Gavin, 1996). The highly differentiated nature of self-concept has led some to suggest that a single global component of self-concept is not adequate in representing the variance in the domain specific components of self-concept and that if one wants to relate self-concept to other constructs “then the specific domains of self-concept are more useful than a general domain”(Marsh & Craven, 1997, p.191). There is also confusion over what a global measure of self-esteem really represents (Marsh & Hattie, 1996) . Of most interest to this research are the findings in relation to the nature of the hierarchy of self-concept. Firstly, in opposition to Shavelson et al. (1976) “global self-esteem is less stable over time and less predictable by significant others than are specific components of self-concept” (Marsh & Yeung, 1998, p.511). Further, with increased differentiation with age the hierarchy tends to weaken. Some have suggested that the structure becomes so weak as to deem it almost indistinguishable (Byrne & Shavelson, 1996). However, this is not enough to disregard the hierarchical model as Marsh and Yeung (1998) have argued that unless correlations across the levels of the hierarchy of self-concept approach zero or one, a hierarchical model still holds.

Shavelson et al. (1976) suggested that before between –construct validity can be ascertained within construct validity must be addressed first. Following this paper theoretical advances in the study of self-concept have progressed to an extent that integration of multi-dimensional self-concept is now apposite. Marsh and Craven (1997) suggested that for this task the domain specific factors of the hierarchy were the most appropriate, while evidence for this has been found for domain specific constructs this theory has received scant attention for domain free constructs such as the Big-Five.

Meta-theoretical models of interaction between self-concept and personality

Research suggests that the Big-Five are relatively enduring, evident in a wide range of behaviours, present across age, gender, race, culture and language, and are possibly biologically and hereditarily based (Costa & McCrae, 1992a). Interestingly, gender differences on the Big-Five tend to be small, with women being slightly higher on
neuroticism, agreeableness and conscientiousness and men slightly higher on openness (Costa & McCrae, 1992c; Costa, Terracciano & McCrae, 2001; Rubinstein, 2005). Based on these findings, particularly those relating to the biological and hereditary bases of the Big-Five, McCrae and Costa (1996, pp. 66-68) have argued for the Big-Five to be considered as the “true core of the individual”.

Support for the Big-Five has come from researchers of a variety of theoretical orientations, and links have been established with major personality instruments (Buss, 1996). While there is some disagreement over the number of basic factors (see Eysenck, 1992) research is now converging on the Five-Factor model (Costa & McCrae, 1992b). Despite this robustness McAdams (1994, p. 146) has suggested that the Big-Five factors cannot provide us with anything more than the “psychology of the stranger”. This claim suggests that while the Big-Five has provided impressive results, it cannot account for the complexity of personality as a whole. Indeed, this difficulty has been suggested, for example by Waller and Ben-Porath (1987) and by McCrae and Costa (1996) themselves; this led them to develop a metatheoretical model to account for the complexity of personality.

Costa and McCrae’s meta-theoretical framework of the structure of personality distinguishes between basic tendencies, such as the Big-Five (neuroticism, extraversion, conscientiousness, agreeableness, and openness) and surface characteristics, that include more malleable personality type of which self-concept is a special adaptation peculiar to the self (Shafer, 2000). While personality traits are suggested to be stable, moderately hereditable and, to a certain degree, influential of behaviour across situational contexts, self-concept and other contextual influences are posited to have little or no effect on these basic tendencies (McAdams, 1994).

While Costa and McCrae’s and McAdams’ model of personality implicitly rejected a reciprocal relationship between self-concept and personality, it seems likely that as personality affects specific components of self-concept the effects of significant life events, interventions, and environmental factors on personality factors may be mediated by self-concept. While there is limited support for such a reciprocal and dynamic relationship, knowledge of the individual and combined influences of the effect of personality factors and self-concept on important dimensions of human experience, may allow for future research to explore the nature of this relationship.

Evidence suggests that the interaction between self-esteem and the Big-Five follows Costa and McCrae’s model (Ridgell & Lounsbury, 2004). Yet limited research had explored whether this model holds for a multi-dimensional and hierarchical perspective of self-concept and basic tendencies, such as the Big-Five. It is also important to establish the veracity of this model compared to alternate models.

Relationship between self-concept, Big-Five and well-being

The limited research available relating to self-concept and the Big-Five tends to focus on a global scale rather than a multi-dimensional perspective. Despite the development of reliable and valid multi-dimensional self-concept measures, research
tends to still rely on single-scale global measures of self-esteem (Shafer, 2000). It is possible that a multi-dimensional perspective has failed to find wide scale acceptance within the broader personality research community or that many of the multi-dimensional instruments are still too large to easily incorporate into a test battery. It seems that a thorough understanding of the interaction between self-concept and the Big-Five will help to establish a multidimensional self-concept perspective within the wider research community.

Surprisingly, despite the central importance of both the Big-Five personality traits and self-concept the two are rarely considered in the same study and when they are considered it is usually a single score global measure of self-esteem that is used. The results of this limited research suggests moderate negative relationships between self-esteem and neuroticism and slightly weaker relationships between self-esteem and extraversion (see Francis & James, 1996; Furr & Funder, 1998; Judge, Erez, Bono, & Thoresen, 2002). In their review, Watson, Suls and Haig (2002) found a moderate to weak relationship between self-esteem and the other components of the Big-Five. Very little research has explored the relationship between a domain specific measure of self-concept and the Big-Five. Asendorpf and Van Aken (2003), one of the few to do such research, found that social self-concept was most closely related to extraversion while self-esteem was most closely related to neuroticism. Other studies have found links to the Big-Five with academic, social, athletic and family self concept (Graziano, Jensen-Campbell, & Finch, 1997; Shafer, 2000). These papers do not seem to endorse a hierarchical perspective. In general it appears that we will not understand the true nature of the relationship between self-concept and the Big-Five until a well developed multi-dimensional measure of self-concept is used to relate the two constructs.

Both self-concept and personality trait research suggests that each construct needs to be evaluated from a multi-dimensional perspective. However, little research has explored the differential effects of these constructs on important human experience, such as well-being, from a multi-dimensional perspective. While some research on domain specific measures of self-concept is present in the literature little has been done on hierarchical multi-dimensional perspective of self-concept. Marsh, et al. (in press) have done such research providing preliminary evidence of systematic patterns of relationships between various personality constructs. However, such research still requires a validated theory such McCrae and Costa’s (1996) to specify the direction and nature of these relationships. Further it is clear that such research must utilise a multidimensional approach to self-concept as Marsh and Craven have suggested that, due to the highly differentiated nature of self-concept Marsh and Craven (1997) have suggested that the individual domain specific components of self-concept are the most appropriate in relating self-concept to other constructs.

Further research needs to validate the relationship between these constructs in relation to important areas of human experience. This has been done in relation to academic achievement but not for non-academic areas important to children in schools such as subjective well-being (Marsh et al., in press). Such research could well use subjective well-being is further given that it is reasonably strongly related to both self-
concept (see Marsh & Yeung, 1999; Schwarz & Strack, 1991) and the Big-Five (see McCrae & Costa, 1999; Diener, Suls, Lucas & Smith, 1999). In line with Diener et al. (1999) we have included separate measures of positive affect, negative affect and satisfaction with life.

Generally integration research includes only the two constructs of interest. However, between-construct research would benefit from the inclusion of a construct that relates highly to both constructs to further clarify the relationship. In this case well-being is the most logical construct as well-being is highly related to both constructs and it is an important non-academic outcome within educational settings.

Use of self-concept, Big-Five and well-being in educational research and practice

Research on multi-dimensional self-concept originally centred on academic self-concept where finding suggested that specific components representing academic domains to have important effects on academic achievement, possibly due to the fact that they are influenced by context, environment and life events (e.g., Bracken, 1996; Byrne, 1996a; Byrne, 2002; Marsh, 1993). Research has suggested that self-concept is a better predictor than self-esteem in relation to academic achievement (Marsh, 1993) and in a longitudinal study self-concept predicted future academic achievement when prior academic achievement was accounted for (Marsh, 1990; Marsh, Byrne & Yeung, 1999). Multi-dimensional self-concept has been found to predict variance in a diverse set of nine academic predictors substantially better than the Big-Five and well-being together and when shared variance between self-concept and the Big-Five is taken into account self-concept still explains a substantial amount of variance in the academic outcome variables whereas the Big-Five uniquely explains less than two percent of total variance (Marsh, Trautwein, Lüdtke, Köller & Baumert, in review). Thus there is evidence to suggest a reciprocal relationship between academic self-concept and academic achievement where cause and effect is attributed to both and both are affected if one is undermined (Marsh, Byrne & Yeung, 1999; Valentine, DuBois & Cooper, 2004).

Support for Marsh et al. (in press) comes from research evaluating the juxtaposition between general intelligence and the Big-Five in predicting academic achievement in first year psychology students. This research suggested that the Big-Five explained moderate but significant variance in achievement (7%) (Ridgell & Lounsbury, 2004). Research suggests that the Big-Five is more stable in predicting success in transition from middle school to high school than self-esteem and that self-esteem exerts its influence on this transition as a results of basic tendencies such as the Big-Five (Hair & Graziano, 2003). Again, this may be due to self-esteem not being a particularly good predictor of academic achievement as compared to self-concept. Correlations were moderate with academic outcomes for the Big-Five, however, the research included outcome variables and non-academic adjustment to high school, with some of the highest correlations between classroom behavior and teacher relationships with the Big-Five (Hair & Graziano, 2003).

It seems that the Big-Five are moderately useful in explaining variances between both academic outcome measures. It is likely that the Big-Five influence within
educational settings is in relating these constructs to non-academic achievement and adjustment within educational settings. Little empirical evidence to date has explored whether self-concept exerts its influence in any area of human experience as a result of basic tendencies, such as the Big-Five, or whether their effects are largely independent.

Future Direction for Research.

It appears that before any meaningful assessment of the neuro-cognitive markers can be explored a firm understanding of the relationship between self-concept and the Big-Five is needed. Further, a meaningful understanding of this relationship should involve the relationship being explored in relation to a construct that is strongly related and often seen as an outcome variable of the two constructs. In this case well-being seems to be the most logical construct and allows for an exploration of how self-concept and the Big-Five uniquely and in combination predict variance in an important non-academic educational outcome. Theoretical models on the structure of personality exist that suggest that the Big-Five exerts its influence through characteristic adaptations such as self-concept. However, little research has explored these models and alternate models from a multidimensional and hierarchical perspective of self-concept. Once the relationship between these constructs has been established the possibility for exploration of neurological and biological markers of these two important constructs can begin. It is suggested that neuro-cognitive tests should be used as the first step in establishing these links.

_Evaluating the juxtaposition of the Big-Five and multi-dimensional self-concept in explaining variance in subjective well-being._

Little research as yet has juxtaposed the Big-Five and a well developed measure of multi-dimensional self-concept in explaining variance in subjective well-being or has evaluation the unique and combined relationships of the Big-Five and multi-dimensional self-concept in predicting variance in subjective well-being. It is suggested that both constructs combined will be able to explain a large amount of variance in well-being and that most of this variance will be uniquely explained by these individual constructs. Self-concept and the Big-Five both correlate quite highly with well-being (Marsh & Yeung, 1999; Schwarz & Strack, 1991; Diener, Suls, Lucas & Smith, 1999) surprisingly however, the correlations between self-concept and the Big-Five are only moderately correlated (Marsh et al., in review). It is difficult to predict how much of this variance will be shared variance or unique variance. Costa and McCrae’s theory would assert that much of the variance would be shared as the Big-Five would exert its influence over well-being through self-concept. This aspect of such research is important as Well-being is an important outcome variable for both self-concept and the Big-Five and thus provides a good basis for clarifying how these two fundamental personality constructs relate to influence important outcome variables.
Evaluating Costa and McCrae’s model of personality in relation to subjective well-being.

While little research is available exploring the interaction between multidimensional self-concept and the Big-Five, one well-established theory, McCrae and Costa’s metatheoretical model of personality (see McCrae and Costa, 1996), specifies both the nature and the direction of the relationships between these constructs. Thus such a model could be used as a basis to explore the Neuro-cognitive markers of both basic personality and characteristic adaptation. Firstly however, a tougher exploration of the empirical validity of Costa and McCrae’s theory in relation to a multi-dimensional view of self-concept needs to occur especially considering Costa and McCrae’s model has yet to be empirically validated in relation to multi-dimensional self-concept. While it has been supported when self-esteem alone was considered (see Hair and Graziano, 2003) it is possible that this model may not hold when a multi-dimensional perspective derived from Shavelson et al.’s (1976) is considered. Further, research must also evaluate of alternate as some have suggested that reciprocal relationships are likely to exist (see Marsh et al., in press).

Cognitive markers of the Big-Five and self-concept.

Given both the expense and difficulty in accessing imagery technology, Neuro-cognitive measures such as reaction time tests and the stroop test, appear to be the most appropriate avenue for a preliminary exploration of the neurological basis of self-concept, the Big-Five and the relationship between them. It is the long-term aim to develop neuro-cognitive and imagery tests that can be used in association with or replace pen-and-paper type tests. The outcomes of such research will hopefully provide Neuro-cognitive markers of these constructs. The limited research available would suggest that self-concept and the Big-Five would not correlate highly with the memory tasks in the cognitive test battery (Klein, Rozendal & Cosmides, 2002) though it is uncertain as to the nature of the relationship with the other cognitive measures such as reaction time and the stroop task. A further complication is the combined use of affective and evaluative judgements in self-concept. It is uncertain whether these aspects of self-concept will result in differential effects on the neuro-cognitive tasks. Neurological and neuro-cognitive links to intelligence are making impressive progress and thus it seems likely that such links could potentially be made with the Big-Five and self-concept as well. It appears from exploration of clinical cases that self-knowledge of personality traits is separate from semantic, episodic and autobiographical memory systems (Klein, Rozendal & Cosmides, 2002). The aim of such research would provide a neurological basis for constructs that are important not only to both academic and non-academic aspects of education given self-concept and the Big-Five factors influence on both academic achievement and students subjective well-being.
Conclusion

Research exploring the neurological basis of important personality constructs must first clarify the relationship between a hierarchical and multi-dimensional perspective of self-concept and the Big-Five. The first step in this process is empirically validating models such as McCrae and Costa’s that specify the nature and direction of relationships between important personality constructs. It is suggested that both self-concept and the Big-Five will be highly useful in explaining a substantial amount of variance in an important non-academic construct of subjective well-being, which while not specifically educational is important to student health. It is an aim of such research to validate the need for both a Big-Five measure and a multi-dimensional measure of self-concept to be used when assessing both academic and non-academic aspects of educational research. These constructs are rarely considered in the same study, yet it is likely that neither one alone can provide the amount of clarity needed to study, predict and design interventions for a wide range of academic and non-academic outcomes. Such research is needed to clarify the relationship between self-concept and the Big-Five so the construct can be uniquely and jointly related to neurological and cognitive markers.

This study is the first step in relating self-concept and the Big-Five to biological and neurological markers. Clinical settings have used many of the cognitive tests involved in this research as indicator tests of neurological functioning (Zappoli, Versari, Arnetoli & Paganini, 1990) and if links between any of the constructs and the cognitive markers are strong enough there is no reason why they could not also be used as personality assessment tools in non-clinical settings provided further research suggest they are reliable and valid. Further to such research imagery studies could be used to further clarify the neurological nature of these personality constructs. The long-term goal is to use cognitive, neurological and imagery testing within educational studies for more pure testing instruments that can come some way to reducing the effect of the test bias and test taking characteristics that plague educational and psychological research. Having said this, there needs to be some empirical exploration of how test bias and test taking characteristics affect neurological and biological assessment. It is likely that biological assessment will be most useful as dual assessment with pen-and-paper assessment (Matarazzo, 1992).

Such possibilities for neurological testing have several advantages for assessments in educational settings. Most importantly they have the potential to bypass test-taking characteristics and test bias by providing a direct observing the construct of interest through implicit means, where the researcher or assessor has more flexibility over the choice of stimuli. Further, as possibilities exist for neurological testing based on real-life simulation of social interactions and real-world challenges such measures may be both more valid and reliable and be more appropriate for children whose speech and language capabilities may restrict the use of traditional pen-and-paper measures that predominate personality research. This is especially important for Australian schools given that many students have English as a second language.


