The life individual resilience scale and cognitive reflection test: predictive utility in special forces selection

Anthony Moffitt

Edith Cowan University

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The Life Individual Resilience Scale and Cognitive Reflection Test:
Predictive Utility in Special Forces Selection

Anthony Moffitt

A Report Submitted in Partial Fulfilment of the Requirements for the Award of Bachelor of Arts (Psychology) (Honours), Faculty Of Health, Engineering and Science.
Edith Cowan University
Submitted 28th October, 2013

Under the supervision of:
Associate Professor Julie Ann Pooley
Dr Guillermo Campitelli

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Abstract

The use of psychometric testing by the military in the screening and selection of its personnel has played a significant role in test development (Aiken, 1997). Several studies have demonstrated the utility of such tests to identify and select elite Special Forces personnel specifically for their employment in complex and dangerous environments (Picano, Roland, Williams, & Rollins, 2006). Research of additional discrete personal attributes beyond traditional cognitive ability and personality traits has inspired studies into the measurement of specific aspects of performance, including perseverance, hardiness and decision-making (e.g., Beal, 2010; Temby & Drobnjak, 2010). However, the empirical evidence for these attributes is limited and additional data is required (Temby, 2011). This study investigated the utility of the Life Individual Resilience Scale (LIRS; Harms, Pooley & Cohen, 2013) and the Cognitive Reflection Test (CRT; Frederick, 2005) to predict candidate outcomes (pass/not pass) on a Special Forces selection course, in a sample of 82 Australian Defence Force personnel. It was hypothesised that successful candidates would score higher in resilience and in cognitive reflection based on these tests. Results showed CRT scores were significantly higher for candidates that passed and predicted success on the course. In contrast there was no significant difference in resilience scores on the LIRS between candidates who passed and did not pass. The implications of the findings are discussed and suggestions for future research are outlined.
For Sandy, Greg, Danielle, Georgia, Henry and Ned.
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Table of Contents

Abstract ......................................................................................................................................... ii
Acknowledgments ..................................................................................................................... v
Table of Contents ....................................................................................................................... vi
List of Tables ................................................................................................................................... ix
List of Figures ............................................................................................................................. x
Introduction ...................................................................................................................................... 1
    Statement of the Study Aim ........................................................................................................ 2

Literature Review

A Brief History of Psychometric Testing .................................................................................... 4
    Intelligence ................................................................................................................................. 4
    Personality .................................................................................................................................. 5
Psychometric Testing in Military Selection ................................................................................... 6
    Previous Research: Testing in Special Forces Selection ......................................................... 8
    Summary .................................................................................................................................. 11

Resilience and Decision-making Ability in Military Selection ..................................................... 12
    Resilience ................................................................................................................................. 13
    Decision-Making ...................................................................................................................... 16
    Summary .................................................................................................................................. 19

The Current Study

Analysis of the LIRS and CRT .................................................................................................... 20
    Study Aim ............................................................................................................................... 20
    Study Hypotheses .................................................................................................................. 21
Method .......................................................................................................................................... 21
    Participants ............................................................................................................................. 21
LIRS AND CRT VALIDITY

Measures ................................................................................................................. 22
  Lifespan Individual Resilience Scale (LIRS) ......................................................... 22
  Cognitive Reflection Test (CRT) ............................................................................. 22
Procedure .................................................................................................................. 23
Results ....................................................................................................................... 24
  Analysis for Hypothesis 1 ..................................................................................... 25
    Comparison of the LIRS scores for groups P and NP ....................................... 25
    LIRS Logistic Regression .................................................................................... 25
    LIRS Factor Analysis .......................................................................................... 26
  Analysis for Hypothesis 2 ..................................................................................... 28
    Comparison of the CRT scores for groups P and NP ....................................... 28
    CRT Logistic Regression ..................................................................................... 30
    Secondary CRT Study Aim ................................................................................. 30
Discussion .................................................................................................................. 31
  Hypothesis 1: LIRS Predictive Validity ................................................................. 31
  Hypothesis 2: CRT Predictive Validity .................................................................. 33
  General Implications of the Study ...................................................................... 36
  Limitations of the Study ....................................................................................... 36
  Future Research Considerations ......................................................................... 38
  The Future of Personnel Selection ...................................................................... 40
Conclusion ............................................................................................................... 42
References .............................................................................................................. 44
Appendices
  Appendix A. Life Individual Resilience Scale ....................................................... 57
  Appendix B. Cognitive Reflection Test ................................................................. 58
Appendix C. Information Letter to Participants ............................................... 59

Appendix D. Consent Form ........................................................................... 62
List of Tables

Table 1. Factor Loadings based on the 12 item Life Individual Resilience Scale (LIRS; \( n = 78 \)) ................................................................. 25

Table 2. LIRS Mean Scores and Standard Deviations for Pass and Not Pass Groups........................................................................... 27

Table 3. CRT Descriptive and t statistics output for scores of Pass and Not Pass Group’s reflective and intuitive scores .................................. 28

Table 4. CRT Logistical Regression Output for Scores of Pass and Not Pass Groups........................................................................... 30
List of Figures

Figure 1. LIRS raw scores negatively skewed distribution for groups P and NP (n = 78). .................................................................26

Figure 2. Mean performance on the CRT for both reflective (correct) responses, and intuitive responses for groups P and NP (n = 78).........................................................29
The Life Individual Resilience Scale and Cognitive Reflection Test: Predictive Utility in Special Forces Selection

Organisational drive for competitive edge and the rapid evolution of information based technologies have realised increasingly complex, dynamic and adaptive work environments. Whilst the focus on strategy, structure and costs within most organisations has advanced commensurately, human capital remains widely undervalued (Wieand, 2003). However, in occupational environments where specific specialised skills, knowledge and abilities are required, organisations recognise the performance and cost benefits of identifying, selecting and training suitable individuals (DeNisi, Hitt, & Jackson, 2003; Hunter & Hunter, 1982). This is particularly important when considering ‘high reliability’ occupational environments where failure can be catastrophic and selection of ‘elite’ individuals, such as astronauts, deep-sea divers or Special Forces (SF) personnel, is critical to successful outcomes (Scherbaum & Meade, 2013).

In traditional personnel selection protocols the suitability of individuals is assessed by various means including interviews and qualification evaluations; and in some cases includes the use of cognitive ability and personality tests. The development of such tests has inspired widespread confidence in the use of psychometric testing as a selection tool in many organisational settings (Jensen, 1998; Scherbaum & Meade, 2013; Schmidt & Hunter, 2004); however, the use of these tests in measuring broader individual differences has exposed some limitations for their application.

These tests have been criticised for being too narrow in their focus, that is, tests measure simple tasks in simple contexts and lack insight into other characteristics of the individual (Danner, Hagemann, Schankin, Hager, & Funke, 2011), and being open to faking (Rothstein & Goffin, 2006). That an individual is assessed as intelligent and personable can inform broader comment about their performance potential in certain situations; however, it
may indicate little about other related cognitive abilities such as decision-making, or attributes such as resilience. These limitations, combined with emerging research into the assessment of additional discrete personal attributes, has generated organisational interest in the utility of specific discriminating measures of individual differences for use in selection protocols.

The problematic nature of testing for more discrete attributes is particularly relevant in elite populations, where group homogeneity can render traditional measures inadequate and reveal potential floor and ceiling effects (Scherbaum & Meade, 2013). It is therefore reasonable to suggest that superior intelligence or agreeable disposition is not equally important across all life domains. For example, in complex and dynamic workplaces, such as hospital, expeditionary and military combat environments, attributes such as resilience may be equally important. Given the difficulty in identifying and assessing these latent qualities, it is important to establish strong theoretical and statistical evidence to support measurement tools (Scherbaum & Meade, 2013). Consequently, the identification of such attributes, their reliable measurement, and their utility in selection processes is of interest to the present study; specifically with regard to resilience and decision-making ability in SF personnel.

**Thesis Statement of the Study Aim**

Contemporary psychometric measures used in the selection of SF personnel, such as cognitive ability and personality tests, are limited in terms of specificity and their ability to measure other important discrete personal attributes (Duckworth & Seligman, 2005; Rothstein & Goffin, 2006; Sternberg, 2012). Tests that measure those attributes have previously shown utility to inform decisions about outcomes on Special Forces Selection Courses (SFSC; Beal, 2010; Temby & Drobnjak, 2009; 2010); however, there remains a gap in the number of studies and amount of data available to empirically support the appropriate use of these tests. The aim of this study is to assess the ability of two psychometric tests, the
Life Individual Resilience Scale (LIRS; Appendix A; Harms et al., 2013) and the Cognitive Reflection Test (CRT; Appendix B; Frederick, 2005), to predict successful completion of a SFSC. This will be important in contributing to previous research by increasing available studies and data; indicate the potential utility of additional tests for predicting successful completion of such courses; and, inform decision making about individuals’ suitability for employment. Further, findings may be used to make broader comment about the utility of such tests as potential selection criteria in other populations.


**Literature Review**

**A Brief History of Psychometric Testing**

Modern cognitive models attempt to identify specific latent aspects to define individual differences, predominantly using intelligence (e.g., cognitive processing or spatial intelligences; McGrew, 2004; Gardner, 1983), and personality (e.g., confidence or friendliness; Eysenck, 1991a; McCrae & Costa, 1996). Intelligence and personality tests, such as the Wechsler Adult Intelligence Scale (WAIS) and Revised NEO Personality Inventory (NEO-PIR) respectively, represent the most evolved forms of psychometric testing, and today consistently demonstrate a robust ability to measure individual differences across clinical, educational and employment domains (Scherbaum & Meade, 2013).

**Intelligence**

Originating in pre-World War I Binet-Simon tests, psychometric test development has evolved continuously over the last century from clinical assessment tools for school children, to complex assessment tools in personnel selection (e.g., Stanford-Binet Intelligence scales; Aiken, 1997; Waters, 1997; Sternberg, 2012). Currently, IQ tests such as the WAIS and Woodcock-Johnson assess cognitive ability in judgement, reasoning, comprehension, vocabulary, and arithmetic, including non-verbal criteria (Anastasi & Urbina, 1997; Kaufman, 2009; Sternberg, 2012). Results of these tests are universally accepted as measures of individual differences in both clinical and non-clinical populations, and have been demonstrated to predict achievement in multiple domains of life including education, health and employment (Deary, 2012; Kaufman, 2009; Strenze, 2007). Cognitive epidemiologists have even gone as far as suggesting that outcomes in these domains are ‘caused’ by intelligence (Batty, Der, Macintyre, & Deary, 2006; Gottfredson, 2006).

Sternberg (2012; pg501) defines intelligence as “one’s ability to learn from experience and to adapt to, shape, and select environments”. The evolution of the theoretical
and practical foundations of intelligence, and therefore its measurement, fundamentally indicates a broader base of cognitive abilities beyond IQ – for example, visual and interpersonal ability (Multiple Intelligence Theory; Gardner, 1983), and, in decision and reaction time (CHC Theory; Flanagan & McGrew, 1998). While revisions continue to increase IQ testing’s cultural, gender and developmental sensitivity, intelligence remains alone as the most predictive cognitive measure of individual differences. Notwithstanding this, debate continues to surround the use of intelligence/aptitude tests. The limitations of these tests are well documented (see Gottfredson & Saklofske [2009] for further discussion) and inform the use of other tests such as those used in the assessment of personality.

**Personality**

Similarly, the psychological construct of personality has its empirical roots in early 20\(^{th}\) Century theorists such as Freud and Maslow. The current understanding about the dimensionality of personality is based on a predisposition to think, feel and act in certain ways and situations, fundamental to personality ‘traits’ (Goldberg, 1993; Cattell, 1946; Eysenck, 1991a). Trait theory currently stands as the most widely accepted model of personality, expressed in the trait based Five Factor Model (FFM; McCrae & Costa, 1996). Evidence for the model’s validity, stability and heritability, including across many cultural contexts, is well documented (Barrick & Mount, 1993; Kenrick, & Funder, 1991; Loehlin, & Martin 2001). Numerous studies support personality as a predictive measure of individual differences across many life domains, including links between personality and job performance (e.g., Barrick & Mount, 1993), and health, social standing and employment (e.g., Hough & Oswald, 2008).

Consequently, personality measures form a significant part of many contemporary personnel selection protocols. The high reliability and validity of tests such as the Minnesota Multiphasic Personality Inventory (MMPI-2; see Ingram, Kelso, & McCord, 2011; Tellegen...
et al., 2006) and NEO-PI-R (see McCrae & Costa, 2010; McCrae, Kurtz, Yamagata, & Terracciano, 2011) allow both general and specific assessments to be made; for example, a doctor may be generally agreeable but specifically cautious, qualities evidently valuable in a doctor’s bedside manner and its link to patient recovery rates (Person & Finch, 2009). Personality testing has emerged as the most widely used psychometric tool in personal selection and research continues to refine its definition and construct (Australian Psychological Society [APS], 2013). However, problems surrounding the tests ‘online over-exposure’ and the potential to ‘fake good’ on many tests have somewhat detracted from their utility (APS, 2013; Rothstein & Goffin, 2006). Based on these limitations, researchers have called for a different approach to the measurement of personality, particularly with regards to children and the elderly (Holder & Klassen, 2010), highlighting the continuing challenges to accurately define and measure personality.

The limitations of such psychometric testing appears not to threaten the integrity of theory or measurement in this realm, nor limit the utility of psychometric testing generally (Sijtsma, 2012); rather, investigations of these limitations serve to inform regular and controlled revisions of such tests (Danner, Hagemann, Schankin, Hager, & Funke, 2011). Exploring the utility of psychometric tests may contribute to the identification and relevance of the existence of separate cognitive abilities beyond IQ and personality as part of the evolving nature of the tests themselves (Sternberg, 2012).

**Psychometric Testing in Military Selection**

There is a long and shared association of psychometric testing with military screening and selection. Many theoretical and practical advances in testing protocols can be attributed to the requirements of military organisations to screen, select and assign large numbers of individuals (Waters, 1997). Particularly in the USA, test development during WWI (Army Alpha and Beta tests) and WW2 (Army/Navy General Classification test) significantly
influenced assessment of individuals in other institutions, including education and immigration. It is estimated that tests had been given to over 15 million individuals during this period, informing later revisions and test development, such as the Wechsler Scales (American Psychological Association [APA], 2013). Since 1950, subsequent test revisions by the US Department of Defense have included the Armed Forces Qualification Test, the General Aptitude Test Battery, and the Armed Services Vocational Aptitude Battery (currently in use), and has inspired military testing regimes globally. Similarly, Australia currently uses the Australian Defence Force General Classification (ADFGC) to assess cognitive ability in its personnel.

The ‘pioneering’ of the psychometric study of cognitive ability testing by the military has stimulated the consideration of other measures beyond cognitive ability, such as personality testing. Consideration of Cattell’s 16 Personality Factors (16PF; 1946) by the Royal Australian Air Force for selection of pilots in the 1950’s (Goyne, 2006) and the use of the US Marine Corps Self Descriptive Inventory (SDI) by the ADF have encouraged the extensive use of personality tests in selection. The 16PF personality assessment is currently used to evaluate the nature of personality in the ADF. More recently, the NEO-PIR has been introduced to help assess the suitability of individuals to work within secretive and sensitive governmental departments, and is currently under review for use as a screening tool for SFSC (A. Butcher, personal communication, October 4, 2013).

However, the NEO-PIR has been found to be limited in indicating personality factors that predict SFSC outcomes. For example, a report by Picano, Roland, Rollins and Williams (2002) found only two out of 80 intelligence and personality measures (E4-activity and A-2 straightforwardness) predicted success on a US SFSC. Further, when the two factors were entered into a logistic regression analysis with a sentence completion test, only the latter was
found to be a significant predictor. Whilst not definitive in isolation, this study does indicate the challenges of relying on traditional ‘general’ psychometric testing in SF populations.

**Previous Research: Testing in Special Forces Selection**

Special Forces personnel are the elite guard of the military and are regularly asked to operate in small teams beyond the geographical and technical scope of conventional forces. To operate in these extreme physically and mentally demanding environments, selected individuals must have above-average physical and cognitive abilities, as well as be ‘tough’ and independent (Picano et al., 2006). The commitment required for a career of this nature includes spending considerable periods of time away from social resources and support structures, which can amplify stressors further (Bartone, 1999). The capacity to endure stress as well as make sound decisions under pressure are considered critical attributes of the modern SF soldier (Picano et al., 2006). Potential candidates are assessed using numerous physiological, psychological and panel/board assessments. Given the increasing reliance on SF personnel in modern militaries (Defence White Paper, 2013), it is sensible to improve the accuracy of selection protocols and therefore increase the likelihood of selecting suitable individuals.

Historically, selection criteria for SF personnel have focussed on physical ability; however, military units worldwide recognise the importance of cognitively adaptable individuals, and therefore, the important role of accurately identifying specific individual characteristics (Hartmann & Gronnerod, 2009). Previous studies into the selection of SF personnel have considered physical attributes, personality factors and cognitive abilities of SF applicants. Though the majority of these studies have been conducted with US SF populations (e.g., Bartone, 1999; 2006; Beal, 2010; Picano et al., 2006; White et al., 2005); studies have also been conducted with Australian, British, Norwegian, and Swedish military samples (e.g.,
Subsequently, other attributes such as resilience and decision-making ability have been identified as universally desirable in SF personnel (Picano et al., 2006); however, assessment is often based on observational and subjective measures by SF unit ‘experts’. Recent studies have explored the utility of specific psychometric tests capable of validating these latent attributes and their potential to predict outcomes on SFSC, including studies in US, UK, Norwegian, Dutch and Australian SF populations. These include, higher cognitive ability, perseverance and specific personality traits (Beal, 2010; Bartone, Roland, Picano & Williams, 2008; Zazanis, Hazlett, Kilcullen, & Sanders, 1999); projective aptitude tests (Hartmann, & Gronnerod, 2009; Picano et al., 2006); hardiness (Bartone et al, 2008; Temby & Drobnjak, 2010); tolerance to ambiguity (Kilcullen, Mael, Goodwin, & Zazanis, 1999); and, mental and physical endurance, motivation and emotional stability tests (Navy SEAL candidates; Taylor et al., 2007).

In recent decades, and at the request of US SF units, the United States Army Research Institute for the Behavioural and Social Sciences (ARI) has conducted several key studies involving cognitive aspects of selection and training in SF populations. These studies explored cognitive adaptability in leadership (White et al., 2005), in which resilience and decision-making ability were identified as key personal characteristics indicative of an individual’s level of adaptability and trainability; and, the role of cognitive ability pre-screening and selection tools for SF selection processes (Brooks & Zazanis, 1997; Zazanis et al., 1999). Research published during this period highlights the effect of psychometric testing’s ability to indicate successful completion of SFSC, and recommends further research into the development of similar specific psychometric tools.
Bartone et al (2008) in particular explored the measurement of psychological hardiness in US Army candidates attempting a US SFSC, using the Dispositional Resilience Scale (DRS). Bartone identified hardiness as a psychological factor associated with resilience as a predictor of success on such courses. After observing the limitation of previous research in this area, including on motivational predictors (Kilcullen et al., 1999), Bartone explored the adaptive qualities of individuals such as commitment, control and sense of purpose. From a sample of 1138, SFSC graduates were found to be significantly higher in levels of hardiness as measured by the DRS, than non-graduates. Bartone concluded, the modest effect size of the positive results indicated that ‘psychological characteristics’, such as hardiness, continue to be explored as predictors of outcomes on SFSC.

More recently, Beal (2010) replicated elements of these studies, and demonstrated the utility of the Grit Scale (a measure of perseverance; see Duckworth, Peterson, Matthews & Kelly, 2007) as a predictor of SFSC outcomes. Findings indicated that the scale is an empirically-valid and independent psychometric measure and is a valuable predictor of SF selection success, but not in isolation. Beal recommends the use of tests such as the Grit Scale, are helpful in the selection of suitable individuals, but that cognitive and physical ability testing may still be the best predictor of success in subsequent SF training, such as languages and close quarter fighting courses. Beal highlights that tests such as this will contribute to the “continued development of assessment techniques” (p. 15) for SFSC. Finally, the study outlines the unique contribution that tests such as Grit and Perseverance, add to well-structured models of selection, particularly in identifying those who voluntarily withdraw (VW) earlier in the screening process. This issue of admission and attrition has influenced other studies, particularly those in Australia.

Australia’s Defence Science and Technology Organisation (DSTO) have recently investigated additional discrete testing measures as predictors of success on SFSC. These
include self-handicapping and mental toughness (Temby & Drobnjak, 2010; Temby & Gucciardi, 2012), and have replicated the findings of Bartone’s hardiness scale (Temby & Drobnjak, 2010). Other innovative research into the utility of projective tests, such as the Rotter Incomplete Sentence Blank (RISB; Rotter, Lah, & Rafferty, 1992; see Temby, 2011) has also provided evidence of an ability to predict outcomes on SFSC.

Based on the predictive limitations of traditional personality tests (Picano et al., 2002) and previous research into the utility of projective tests such as inkblot and sentence completion (e.g., Hartmann & Gronnerod, 2009; Picano et al. 2006), Temby’s (2011) study provided evidence that projective tests can “discriminate between ‘completers and non-completers’ of military training” (p. 7). Temby recommended the further use of projective tests (i.e., RISB) in future studies of military populations, and in particular in the SF selection context. As a result, researchers concluded that a need to identify and develop more discriminating measures of performance is warranted (Temby, 2012).

These studies have demonstrated some reliability in predicting outcomes on SFSC courses, and appear to be less susceptible to criticisms of faking and socially desirable responding (e.g., Hartmann, & Gronnerod, 2009; Temby, 2011). Researchers recommend further exploration of these types of tests for use in discriminating between successful and unsuccessful applicants. Other recent Australian based studies into the measurement of psychological characteristics (see Hetebry, 2010, and McCormack 2004) also reinforce the growing desire of militaries to find better predictors of success in military environments.

Summary

The attempt to identify and measure attributes, such as hardiness, perseverance, grit and mental toughness, indicate a strong and on-going desire to build practical research pathways to improved specific criteria for use in SF selection processes. Whilst the findings of researchers such as Bartone and Temby support continued research in this area, the evident
short history of research in SF populations provides a limited amount of studies, and therefore data, on which to base subsequent research. Clearly, gaps remain in wider empirical understanding about specific attributes, and how best to measure them in SF selection. Further, given previous research findings and recommendations, the limitations of standard psychometric tests (personality and intelligence), and the apparent cognitive and psychological differences between successful and unsuccessful SF candidates, it is reasonable to endorse this present exploration of additional psychometric testing in SFSC. With relation to resilience and decision-making in the present study, the theoretical foundations and previous research of the LIRS and CRT, and their relevance to the current study, is discussed below.

**Resilience and Decision-making Ability in Military Selection**

Similar to US military studies, research within the ADF is examining how individuals can increase their adaptability in stressful situations (e.g., Cohn, Crane, Hodson, & Lewis, 2010; Temby & Gucciardi, 2012) and, their decision-making ability (e.g., Grisogono & Radenovic, 2011). These studies aimed at improving resilience and decision-making, and ultimately the individual’s ability to operate in demanding and uncertain circumstances. Definitions of resilience indicate how individual features relating to personal strength and affirmative consequences following exposure to adversity lead to adaptive coping (Wald, Taylor, Asmundson, Jang, & Stapleton, 2006); that is, resilience indicates successful adaptation to adversity (Harms et al., 2013). Similarly, decision-making ability has been demonstrated to be an adaptive process in that it “plays an important role in the adaptation of individuals to different environments and situations” (Frederick, 2005, p. 188).

Previous research confirms the importance of resilience and decision-making as essential attributes for elite military personnel (Picano et al., 2006); however, there are limited published studies that empirically support the utility of these attributes (and their
associated predictive qualities) for selection purposes. Therefore, the following sections provide a brief overview of research into resilience and decision-making as attributes of interest in military samples.

**Resilience**

Traditionally, members of western armed forces have been viewed as stoic, or resilient. Evans (2010) contends that as warfare has changed to be more about ‘hearts and minds’ it is the soldier’s ‘heart and mind’ which are often sacrificed within the constraints of today’s asymmetric and ambiguous combat environments. Perhaps this is best illustrated by the ‘epidemic’ rise in psychological disorders amongst contemporary western forces (Murray, 2002). Further, wider influences of popular culture mean that finding self-less or ‘bullet-proof’ minded personnel can be difficult, and resilience should no longer be taken for granted.

Long held definitions of resilience surrounded the physical and psychological ability to cope with stress. Historically, individuals who were not obviously affected by traumatic events were considered to have a degree of personality pathology (Osterweis, Solomon, & Green, 1984). However, this has been disputed more recently, in that it is recognised that personal resilience is expressed differently among individuals and in some situations can be adaptive (Bonanno, 2004). These studies mostly focus on populations post adverse experiences. Currently, there is an increased interest in measurement of resilience as a predictive tool in identifying individual differences for selection purposes; this is seen as being particularly important in individuals operating in high stress settings, such as combat environments (Bartone et al., 2008).

Resilience can be defined as the potential of an individual to be resourceful in the face of challenging circumstances, and has been characterised by one’s control of both internal (such as health, social competence and capacity) and, external influences (such as family and
social support; Lerner & Benson, 2003; Luthar, 2003; Rutter, 1987). Subsequent studies have identified aspects such as personal resources, additional to cognitive skills, as major constituents of resilience and mental toughness in athletes and military personnel (e.g., competitiveness, confidence and positive outlook; Galli & Vealey, 2008; Pickering, Hammermeister, Ohlson, Holliday, & Ulmer, 2010). Many key psychosocial attributes that foster resilience have also been identified and include self-esteem, self-efficacy, optimism, self-mastery, internal locus of control, ego strength, confidence, perseverance and flexibility (e.g., in military populations; Pickering et al., 2010). These attributes are important in an individual’s ability to ‘bounce-back’ to normal or higher levels of functioning following exposure to adverse experiences, as maybe the case in post-traumatic growth¹ (Flach, 1997). Importantly, the concept of post traumatic growth alludes to the potential of training an individual to become more resilient.

Bonanno (2004) contends that many studies indicate that more than half of the US civilian population will experience a traumatic event at some stage in their life, as defined by revisions of the Diagnostic and Statistical Manual of Mental Disorders (e.g., 5th ed.; APA, 2013). Further, only 5-10 per cent will be significantly and adversely impacted. This indicates that around 90 per cent of those affected will display resilience, in that they will recover and in some cases grow from their experiences. This supports the notion that resilience may be based on specific personal attributes such as self-enhancement and positive emotions, as well as being linked to intelligence, family background and emotions (Bonanno, 2004; Folkman, 2008).

Resilience has been identified as an essential attribute for elite personnel (Picano et al, 2008), and as such has been central in some military focussed research (e.g., Bartone, 1999; Bartone et al., 2008; Wald et al, 2006). Previous studies have linked success on SFSC to

¹ Post traumatic growth occurs in individuals when adaptive re-integration takes place, leading to further protecting features, i.e., building resilience.
higher levels of resilience related characteristics, such as emotional stability, likeability and tolerance to stress (e.g., using the Hogan Personality Inventory; Hogan & Hogan, 1989; McDonald, Norton, & Hodgson, 1990); adaptability, trainability and resilience building (e.g., using the Dispositional Resilience Scale [DRS]; Bartone, 2006; Hannah, Balthazard, Waldman, Jennings, & Thatcher, 2013; White et al., 2005); hardiness (Bonanno, 2004; Temby & Drobnjak, 2010); and, low levels of self-handicapping (a British military sample; Richards, Johnson, Collins, & Wood, 2002; Temby & Drobnjak, 2010). Consequently, the measurement of resilience has been highlighted as an important area for future research in SF personnel, specifically the individual’s capacity to ‘be’ resilient and its relationship to adaptive performance (Bartone, 2006; Temby & Drobnjak, 2009; 2010). As such, various US military studies into hardiness as a measure of resilience have indicated predictive utility in selecting leaders as well as success on SFSC (e.g., using the Grit Scale; Beal, 2010; Bartone, et al., 2008; Temby & Drobnjak, 2010). Whilst resilience studies on Scandinavian populations indicate some generalizability of these findings outside US military populations (Bartone, Johnsen, Eid, Brun, & Laberg, 2002), Australian military personnel have not been extensively studied in this area (cf. Temby & Drobnjak, 2010).

Being able to predict and assess the magnitude of individual resilience has demonstrated utility in selecting individuals for employment in combat environments (Bartone et al., 2008, in Lepez, van de Ven, & van Gelooven, 2010), but evidence is limited. Similar to Bartone’s (2008) DRS (measures pre exposure hardiness) the LIRS (Harms et al., 2013) offers potential to evaluate an individual’s pre-existing resilience levels, based on availability of internal and external resources; however, the scale has so far only demonstrated potential to measure individual resilience in university populations. Given this, and the limited amount of evidence available of resilience based measures’ predictive qualities in Australian SF samples, the LIRS presents an opportunity for the present study to
test its utility in the military context. It is expected that the study will contribute to the growing understanding of the important of resilience as an attribute, and its measurement as a predictor of success on an SFSC.

**Decision-Making**

Decision-making ability is understood to be central to adaptability, a desirable characteristic aspect of the SF soldier (cf. Taylor et al., 2007; White et al., 2005). Surprisingly, it has received little attention from empirical studies of military populations within Australia. Whilst decision-making has been linked to general intelligence (Lubinski, 2009), Frederick (2005), in his cognitive ‘traits’ approach, identifies that the lack of consideration of judgement and decision-making in assessing IQ is a weakness of traditional testing protocols; in that, too often ‘other’ cognitive (individual) differences are disregarded in studies as ‘unexplained’ variance.

Decision-making is a cognitive process by which individuals make “choices among alternatives” (Klein, 2008; p. 456) to resolve a particular problem or deficit - a problem solving activity. According to Balasubramanian, Parimala, Fathima, and Mohan (2013), decisions are at the core of cognition itself, and that thinking can be largely considered a problem solving process. The study of thinking, and therefore its apparent overlap with decision-making, has its roots in the research of Woodworth (1869-1962) and is highly complex in nature - decision-making includes interpretation, imagining, language and physiological elements. In the past, research approaches have explored this construct using economic normative models of decision-making, mostly based on informed rational individuals seeking optimal choice through maximising utility of resources (e.g., Vroom & Yetton, 1973).

Until recently, decision-making researchers predominantly focused on optimal models of decision-making. That is, they tried to understand how people made decisions in structured
and controlled environments. It is currently understood that individuals make decisions based on a range of influences including reason, heuristics, emotions and environment (Kahneman, Slovic, & Tversky, 1982; Klein, 2008). Assessing decision-making ability is difficult in that the complexity of contexts, methods and types of decisions make it a broad domain. Therefore, many models of assessment of decision-making ability are broken into smaller constituent parts including rational, collaborative, normative and naturalistic types of decision-making (Jonassen, 2012). Assessing decision-making ability in individuals for selection purposes is problematic, and therefore is best designed to assess individual’s abilities in specific environments – the importance of decision-making ability in the military context is obvious. As the entire domain of decision-making may be considered too broad for the scope of this present study, subsequent discussion will focus on normative and naturalistic decision-making processes, as being the most relevant to the current study.

Kahneman, Slovic and Tversky (1982), amongst others (see Simon’s Bounded Rationality in Campitelli & Gobet, 2010), challenged normative decision research arguing that individuals do not adhere to ‘optimal performance’ principles based in algorithms; rather, individuals used heuristic strategies. By challenging human decision-making models based in laws of probability and utility theories, Kahneman et al. identified how individuals don’t always make decisions based on systematically generated alternative options or equally evaluative mechanisms. On top of systematic evaluation techniques (normative models), individuals regularly make decisions based on unconscious motivation, emotions and previous experience. This apparent ‘synthesis’ of deliberate and intuitive decision processes permits the immediacy of a situation, or necessity of a decision, to dictate moving between analytic and intuitive approaches; a ‘naturalistic’ decision-making model (NDM; how individuals actually make decisions in the real-world setting; Klein, 2008).
Linked to NDM, research by Klein (2008) for example, provides evidence for a recognition-primed decision model (RPD) that illustrates how fire-fighters may move between normative processes - generated from fire-fighting training and protocols; and, naturalistic processes - in that, as fires grow exponentially they are forced to rely more on intuition and past experience, learned over time in the form of pattern of repetition². Klein offers that RPD is a “blend of intuition and analysis” (p. 458), a model that nests well with the cognitive dual system theories put forward by Kahneman (2003; for an overview, see Evans, 2008). Stanovich and West (2000; in Frederick, 2005) went further to categorise this dual system as ‘System 1’ and ‘System 2’ respectively.

System 1 is characterised by quick and unconscious (intuitive) decisions made with little effort or thought. System 2 is characterised by more reflective and deliberate rational (analytic) processes using concentration and often involving learned processes (Frederick, 2005). For example, a simple mathematical equation such as ‘2 x 2’ can be completed using System 1; whereas, finding the square of 8220663 would require attention from System 2. With relation to the fire-fighting example; a purely intuitive approach (System 1) to fighting a fire would be risky as it may generate flawed options; whereas; a purely deliberative approach (System 2) may be too slow in reacting to a fire that could quickly get out of control. This suggests an optimal fluid model freely utilising both systems.

Similar to the environments of fire-fighters, military personnel must regularly make rapid decisions due to time pressure, incomplete information and limited options, alluding to the employment of both systems. Though limited US SF studies have indicated the utility of decision-making assessment as selection criteria (Taylor et al., 2007; White et al., 2005), results do not appear to have been tested for generalizability in other military populations. There appears to be a significant gap in empirical studies of the utility of decision-making as

² Individuals build up patterns of behaviour based on past situational cues, expectation, goals and reactions.
a measure of individual difference in military populations. As far as the author is aware, no such studies have been conducted in Australian SF. The CRT has so far demonstrated utility as a measure predominantly in university populations; and therefore, offers the present study an opportunity by which to assess this ability in Australian SF personnel.

**Summary**

Finally, the real world (macro cognitive) research of Klein (2008) indicates a need to appreciate a broader and interrelated set of cognitive functions and attributes, as part of a mixed-model approach to explaining individual differences (see dual system studies by Serfaty, MacMillan, Entin, & Entin, 1997). Support for the measurement of additional attributes, such as resilience and decision-making ability, might increasingly be seen as a part of an integrated and multi-dimensional approach to measuring individual differences. Bonanno (2004), Luthar (2003) and Bartone et al. (2002) suggest that future investigations need not only look at resilience as a measure of recovery, but as a broader concept (of personality) that includes cumulative, interactive and latent qualities. Equally, Frederick (2005) highlights that cognitive abilities beyond intelligence, such as cognitive reflection, inform decision-making and that research is required into why individuals of similar intelligence can make very different decisions based on problem solving measures.

Perhaps the usefulness and relevance of continuing to study these additional attributes is most authoritatively identified by Sternberg (2000, in Frederick, 2005), contending that “to characterise people with high SAT scores as those who should set the norm for what is somehow true or right seems to be off target. People with high SAT scores have high levels of certain kinds of cognitive abilities. They have no monopoly on quality of thinking and certainly no monopoly on truth” (p. 697-698). Research into the measurement of these attributes beyond IQ and personality has relevance and merit, particularly in Australian SF populations.
The Current Study

Analysis of the LIRS and CRT

Currently, candidates identified to enter into the SF selection process are subject to an exhaustive number of predictive measures of performance, including numerous psychometric measures, supervisor ratings, physiological achievement thresholds and ultimately pass or not criteria. The imperative to select suitable individuals, demands that appropriate measures are utilised and that those measures are not only relevant but are accurate and empirically supported, therefore evidence based. Further, such measures should mutually support a wider process. As has been discussed, intelligence and personality testing have shown validity and reliability in predicting success in various life domains. However, as the above discussion has identified those tests’ limitations and emerging evidence (e.g., Bartone, et al., 2008) indicates further useful discrete measures of individual differences.

SF units constantly assess their own development and growth, including psychometric testing used in their selection processes. It is therefore reasonable to suggest that beyond extant valid tests it is wise to seek additional measures that may offer increased specificity of desirable and more discrete attributes of an individual, and therefore inform performance based assessment and selection decisions.

Study Aim

The aim of this study is to assess the ability of two psychometric tests, the Life Individual Resilience Scale (LIRS; Appendix A; Harms et al., 2013) and the Cognitive Reflection Test (CRT; Appendix B; Frederick, 2005), to predict successful completion of a Special Forces selection course (SFSC).
Study Hypotheses

It was theorised that candidates who passed (P) selection would score higher in both the resilience and decision-making ability than those who did not pass (NP). Therefore, the following two hypotheses were developed;

H1: Overall scale scores on the Life Individual Resilience Scale will predict successful completion of candidates who attend a SFSC.

H2: Overall test scores of the Cognitive Reflection Test will predict successful completion of candidates who attend a SFSC.

Additionally, two secondary aims were developed for the study, 1.) as the LIRS is in development, this study will assess the factorability and internal consistency of the LIRS items to assist test developers; and 2.) to examine whether the CRT is a measure of decision-making ability independent of intellect, through conducting analysis on score differences between Officers (tertiary qualified) and Other Ranks (traditionally not tertiary qualified)\(^3\).

Method

Participants

Eighty two ADF members took part in the study. Four participants were withdrawn during the course due to serious injury, and therefore were not considered in the final sample for analysis, as they did not satisfy conditions for the study - namely belonging to group P or NP. The sample \((n = 78)\) was comprised of all male subjects ranging in age from 21 to 37, with an average age of 26.67 years \((SD = 3.51)\). Military ranks within the sample ranged from Private to Captain, and included 17 Officers and 61 Other Ranks (ORs)\(^4\).

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\(^3\) The author recognises that education does not equal intelligence; however, results based discussion about this is considered helpful to highlight future research in this area, particularly to gain insight into military populations.

\(^4\) Other Ranks (ORs) include Warrant Officers, Sergeants, Corporals and Privates.
Measures

Lifespan Individual Resilience Scale (LIRS)

The LIRS (Harms et al., 2013) is based on a hierarchical and three-factor model of resilience conceptualised by Pooley and Cohen (2010; in Harms et al., 2013). The scale has been designed to measure pre-existing adaptive aspects of individual resilience that may ‘buffer’ individuals, as opposed to other scales’ focus on outcome based measures. Further, the scale developers are concerned with addressing the length of previous time consuming scales, as well as its usefulness for both adult and adolescent populations.

The LIRS consists of three 4-item factor scales (12 items in total) designed to measure individual resilience across three resource based aspects of resilience: Personal Resources (PR); Social Resources-Peers (SR-P); and Social Resources-Family (SR-F). Respondents are asked to rate the importance of items such as “My friends look after me” and “I feel safe within my family” using a 7-point Likert-type scale ranging from strongly disagree (1) to strongly agree (7). The hierarchical three factor scale was developed using structural equation modelling that indicated sound psychometric properties (RMSEA < 0.05; Harms et al., 2013). The LIRS is still in development and as such has limited empirical support at this time. Further studies on populations beyond university students are required; therefore, the current study provided an opportunity to assess the factor specific qualities of the LIRS and its potential as a predictive tool in the selection of SF personnel.

Cognitive Reflection Test (CRT)

The CRT (Frederick, 2005) measures “the ability or disposition to resist reporting the response that first comes to mind” (Frederick, 2005, p. 35). The test has demonstrated good predictive qualities for assessing decision-making ability in individuals; including, bias and fallacy avoidance (see Frederick, 2005; and, Campitelli & Labollita, 2010). It is designed to
measure an individual’s cognitive ability in allowing reflective ‘deliberate’ decision-making to override quick ‘intuitive’ decisions when required.

The CRT is a 3-item measure of one aspect of cognitive ability in decision-making – specifically, cognitive reflection. The test consists of 3 right/wrong questions; for example, “A bat and a ball cost $1.10 in total. The bat costs a dollar more than the ball. How much does the ball cost? ____ Cents” Correct responses receive 1 mark for a possible maximum score of 3, and assessment is based on a score out of 3 for the deliberate or reflective correct answers (CRT-R). Therefore, respondents who score higher (more correct answers) on the CRT are considered to have increased reflective decision-making ability.

Additionally, scores for the quick or intuitive incorrect answers (CRT-I; indicative intuitive answers are supplied with the test) can also be meaningful in that ‘expected’ intuitive answers can be analysed to highlight respondents who cannot resist reporting the response that first comes to mind, and therefore rely on system 1 to make their decisions. For example, the CRT-R (correct) answer for the above question is 5 cents; whereas, the CRT-I (intuitive) answer is 10 cents.

As far as the author is aware, the CRT has not been used in military populations, and therefore, the current study provided an opportunity to assess the thinking disposition of cognitive reflection and its potential as a predictive tool in selection of SF personnel.

Procedure

Ethics approval was obtained from both the Australian Defence Human Research Ethics Committee (ADHREC) and the Edith Cowan University Human Research Ethics Committee (ECU-HREC). In addition, approval was also secured from the Commanding Officer of the SF unit involved. Participants were administered a test booklet, containing an information sheet, a consent form, the 12-item LIRS and 3-item CRT (Appendix A & B), in a supervised classroom setting located within the SF facilities. Importantly, testing was
conducted on the day prior to the commencement of the selection course, in July 2013, and prior to any assessable part of the selection course being conducted. The participants were verbally briefed on the conduct of the testing, including that they could take as much time as they required in completing the booklet. Participants were not required to record their name; rather, individuals were briefed to record their allocated candidate number and age. Upon completion of the testing, all booklets were collected, checked for de-identification and secured by selection course staff. Upon the completion of the SFSC (four weeks later), the booklets and the results of the course (P or NP) were handed to the researcher for analysis which was conducted using SPSS for Windows software (version 21.0). The researcher had no means by which to relate results of the testing or the SFSC to the identity of individuals.

Participants were briefed verbally about the confidentiality of their personal information and the results from the testing; further, it was highlighted that the results of this present study would not form part of the selection criteria for the course. This information was also included in the written test instruction and consent form. Participants were informed that testing was not compulsory and were offered the opportunity to ask any questions or receive debriefing if they wished.

Scores in the LIRS and CRT were subsequently compared to the results of the selection course; in that, the P and NP groups were compared to explore relationships between test scores and selection outcomes, in line with aforementioned hypotheses.

**Results**

Of the 82 participants that attended the SFSC 20 (24%) were selected (P) and 58 (71%) were not selected (NP). As 4 (5%) participants were withdrawn from the course due to serious injury, the following statistics are reported on a sample of \( n = 78 \).
Analysis for Hypothesis 1

Comparison of the LIRS scores for groups P and NP

Due to the violations of normal distribution assumptions for the LIRS scores (negatively skewed), nonparametric analysis was conducted to compare differences between P and NP scores. A Mann-Whitney test indicated that there was not a significant difference in LIRS scores between P ($M_{dn} = 77.50$) and NP ($M_{dn} = 78.00$), $U = 547.50$, $p = 0.71$, $r = 0.04$; for descriptive statistics see Table 1. It should be noted that the average response value for all items from all respondents was $M = 6.41$ ($SD = 0.29$) of a possible value of 7; additionally, the average overall score on the LIRS was $M = 76.97$ ($SD = 5.49$) of a possible 84. These average scores indicate that approximately 98% of the respondents scored above the 75th percentile for the sample, which supports the significant negative skew in the distribution for raw scores for the sample (see Figure 1).

LIRS logistic regression

Further, a logistic regression did not support resilience as measured by the LIRS as a predictor of whether participants passed the course ($p > 0.05$). The obtained odds-ratio of 1.017 (95%CI: 0.93, 1.12) indicates that for every point increase in LIRS resilience score the probability of not passing the course is increased by 1.7%. Overall, these results do not support the hypothesis that LIRS scores were a predictor of success on the selection course.

Table 1

<table>
<thead>
<tr>
<th>Outcome</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pass</td>
<td>20</td>
<td>76.60</td>
<td>5.34</td>
</tr>
<tr>
<td>Not Pass</td>
<td>58</td>
<td>77.10</td>
<td>5.58</td>
</tr>
<tr>
<td>Total</td>
<td>78</td>
<td>76.97</td>
<td>5.49</td>
</tr>
</tbody>
</table>

*Sample normal distribution assumptions violated.
Figure 1. LIRS raw scores negatively skewed distribution for groups P and NP (n = 78).

**LIRS Factor analysis**

Finally, as part of the secondary aim of the study of the LIRS, a factor analysis of the structure and design of the scale was conducted. The 12 item, 3 factor LIRS had a Cronbach alpha value of $\alpha = 0.82$, and thus was considered to have good internal consistency and overall a reliable scale (George & Mallery, 2003). As the LIRS is still in development, the factorability of the 12 LIRS items was examined.

Several criteria indicated good factorability of the 12 items, including that all items correlated with more than half of the other items by at least 0.3; the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy value was 0.64 (above the recommended value of 0.6; Coakes, Steed, & Dzidic, 2006); Bartlett’s test of sphericity was also significant, $\chi^2 (78) = 394.94, p < .05$; and, the anti-image correlation values were all above 0.5, with the exception
of item 3 which had a value of 0.44 (Coakes, Steed, & Dzidic, 2006). Given these indicators, and the fact that all communalities were above 0.5 (see Table 2) the 12 items were assessed as suitable for their inclusion in the factor analysis. Finally, the three factor solution was supported via Principal Components Analysis in that over 63% of the variance was accounted for by the three factors, based on eigenvalues > 1. Varimax rotation was selected for the final solution due to the negligible difference in the oblimin rotation output.

Table 2

*Factor Loadings based on the 12 item Life Individual Resilience Scale (LIRS; n = 78).*

<table>
<thead>
<tr>
<th></th>
<th>Component 1</th>
<th>Component 2</th>
<th>Component 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q 11</td>
<td>.861</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Q 6</td>
<td>.827</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Q 9</td>
<td>.787</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Q 2</td>
<td>.677</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Q 4</td>
<td></td>
<td>.811</td>
<td></td>
</tr>
<tr>
<td>Q 7</td>
<td></td>
<td>.807</td>
<td></td>
</tr>
<tr>
<td>Q 12</td>
<td></td>
<td>.782</td>
<td></td>
</tr>
<tr>
<td>Q 3</td>
<td></td>
<td>.665</td>
<td></td>
</tr>
<tr>
<td>Q 8</td>
<td></td>
<td></td>
<td>.804</td>
</tr>
<tr>
<td>Q 1</td>
<td></td>
<td></td>
<td>.743</td>
</tr>
<tr>
<td>Q 10</td>
<td></td>
<td></td>
<td>.674</td>
</tr>
<tr>
<td>Q 5</td>
<td></td>
<td></td>
<td>.594</td>
</tr>
</tbody>
</table>

*Extraction Method: Principal Component Analysis.*

*Rotation Method: Varimax with Kaiser Normalization.*

a. Rotation converged in 5 iterations.

b. Factor loadings < 0.5 are suppressed.

Overall, three distinct factors were found to underlie participants’ responses to the LIRS, commensurate with the nominated scale factors, and thus were found to be acceptable
to good in terms of internal consistency, and therefore all items in the Harms, Pooley and Cohen (2013) factor structure were retained.

**Analysis for Hypothesis 2**

*Comparison of the CRT scores for groups P and NP*

Both ‘System 1 – intuitive’ (CRT-I) response scores and correct answer ‘System 2 – reflective’ (CRT-R) response scores from the CRT for both samples (P and NP) were subjected to independent samples t-test analyses; descriptive statistics for both are shown at Table 3.

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>M</th>
<th>SD</th>
<th>t</th>
<th>p</th>
<th>d</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pass</td>
<td>20</td>
<td>1.75</td>
<td>1.10*</td>
<td>0.91*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not Pass</td>
<td>58</td>
<td>1.12</td>
<td>1.69*</td>
<td>1.06</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>78</td>
<td>1.28</td>
<td>1.54*</td>
<td>1.08*</td>
<td>2.31</td>
<td>0.024</td>
</tr>
</tbody>
</table>

**Note:**
- Cohen’s d (effect size) also displayed.
- Intuitive CRT-I statistics shown in italics.
- Equal variance for intuitive CRT-I scores not assumed.

Overall CRT scores were significantly higher for group P (M = 1.75, SD = 1.02) compared to group NP (M = 1.12, SD = 1.06), t (76) = 2.31, p < 0.05 (two-tailed). The 95 per cent confidence interval of the mean difference between the groups is located between 0.09 and 1.17, and the assumption of homogeneity of variance was not violated, p > 0.05; further, there was a moderate to high effect size (d = 0.60; Cohen, 1988). This result provide evidence
that decision-making ability as measured by the CRT significantly discriminated between P
and NP outcomes on the SFSC, consistent with Hypothesis 2.

The Cronbach alpha value for the CRT test was 0.58, comparable to values reported in
previous studies involving the CRT; for example, Campitelli and Gerrans (in press) \( \alpha = 0.66 \),
and Weller et al. (2013; in Campitelli & Gerrans, in press) \( \alpha = 0.60 \).

Additionally, and independent of Hypothesis 2, considering Frederick’s theoretical
explanations of the ‘System 1 – intuitive’ thinking disposition - in that it indicates respondents
are more likely to report the answer that first comes to mind; the CRT-I scores were also
subjected to an independent samples t-test analysis; equal variances were not assumed. CRT-I
scores were significantly lower for group P (\( M = 1.10, SD = 0.91 \)) compared to NP (\( M =
1.69, SD = 1.09 \)), \( t(39.37) = 2.36, p < 0.05 \) (two-tailed); CI95\% = -1.09, -0.08. Apparent
‘inversely’ related scores of CRT-R and CRT-I scores are illustrated by histogram at Figure 2.

*Figure 2.* Mean performance on the CRT, for both reflective (CRT-R; correct) responses and
intuitive (CRT-I) responses, for groups P and NP.
**CRT logistic regression**

Finally, the results of logistic regression analysis provided support for CRT scores being a predictor of whether candidates passed the SFSC ($p < 0.05$; see Table 4). The best model fit ($\chi^2 (1) = 5.15; p < 0.05$) based on NP as the reference group, showed that CRT scores predicted a candidates outcome in 74% of cases. Further, the obtained odds-ratio of the best model, 0.571 (95%CI: 0.35, .94), indicated that for every point increase in the CRT score the probability of ‘not passing’ the course ‘decreased’ by 42.9 %. Put simply, an inverted odds-ratio is approximately 2 to 1, and therefore, for every 1 point increase on the CRT those individuals from the NP group would have been approximately twice as likely to pass the selection course.

Table 4

*Logistic Regression Output for CRT Scores of Pass and Not Pass Groups*

<table>
<thead>
<tr>
<th></th>
<th>B</th>
<th>S.E.</th>
<th>Wald</th>
<th>df</th>
<th>Sig.</th>
<th>Exp(B)</th>
<th>95% C.I.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CRT Score</td>
<td>-.560</td>
<td>.255</td>
<td>4.829</td>
<td>1</td>
<td>.028</td>
<td>.571</td>
<td>.347</td>
</tr>
<tr>
<td>Constant</td>
<td>1.868</td>
<td>.484</td>
<td>14.923</td>
<td>1</td>
<td>.000</td>
<td>6.474</td>
<td></td>
</tr>
</tbody>
</table>

a. Variable(s) entered on step 1: CRT Score.

**Secondary CRT study aim**

As part of the secondary aim of this study of the CRT, t-tests were conducted on both reflective and intuitive CRT scores from group P only, to compare Officers and ORs. CRT-R scores were not significantly different between Officers ($M = 2.20, SD = 0.84$) and ORs ($M = 1.60, SD = 1.06$), $t (18) = 0.26, p > 0.05$ (two-tailed); CI95% = -1.69, 0.49. Similarly, CRT-I scores were not significantly different between Officers ($M = 1.20, SD = 0.94$) and ORs ($M =
0.80, $SD = 0.83$), $t (18) = 0.84, p > 0.05$ (two-tailed); CI95% = -0.59, 1.39; equal variances were assumed for both.

**Discussion**

The purpose of this study was to assess the ability of two psychometric tests, the Life Individual Resilience Scale and the Cognitive Reflection Test, to predict successful completion of a SFSC. The importance of resilience and decision-making in SF populations has been highlighted in previous research (e.g., White et al., 2005); however, there has been limited studies examining the measurement of these factors and whether they provide predicative utility in SF screening and selection. Therefore, this study addressed the identified gap in research in this area. Results indicate the predicative utility for the CRT, but not for the LIRS.

**Hypothesis 1: LIRS Predictive Validity**

The first hypothesis was that LIRS scores would predict successful completion of the SFSC. The results did not support this hypothesis; therefore, the LIRS did not show predictive utility for selection of SF personnel in this study. This outcome is in contrast with previous studies that have found evidence that resilience-related measures predict outcomes on SFSC within Australia and overseas (e.g., Bartone, 2006; Picano et al., 2006; Temby & Drobnjak, 2010).

There are several possible reasons for the non-significant findings and difference in outcomes between the current and previous studies. One possible reason is the high mean scores and negatively skewed data for the sample, which indicate that almost all candidates are high in resilience as measured by the LIRS. An explanation for this result may be that screening and pre-selection physical and psychological measures have rendered the sample group largely homogenous and the LIRS lacks the specificity to discriminate between groups.
in this sample. Further, the result may be explained in that individuals that attempt the SFSC actually do display considerably higher than average levels of individual resilience.

Given that the LIRS is in development, the secondary aim of the LIRS analysis in this study was an exploration of the scale structure and design. The findings of this study provide support for the three factor structure (personal resources, social resources-family, and social resources-friends) of the LIRS previously proposed by Pooley and Cohen (2010). However, definitive confirmation of whether the three factors are subsumed under a single over-arching construct, or are separate elements of resilience as hypothesised by the designers, is not possible. The study also supports the twelve item LIRS as a brief and simple tool to administer, which may represent a significant development in testing of resilience when compared to other longer scales used by the ADF, such as the 37 item Resilience Scale for Adults (RSA; Friborg, Hjemdal, Rosenvinge, & Martinussen, 2003, see Hetebr, 2010).

Given the brevity of the scale, passive clinical and non-clinical administration of the test may be possible and therefore considered in the future.

Two major limitations of the LIRS were identified during the study. Firstly, regardless of the reiteration of the fact that LIRS scores did not impact on a candidates’ potential to pass the SFSC or not, there is no way of assessing levels of ‘faking-good’ on the test. As previous studies by Picano et al. (2002) have demonstrated, demand effects of testing may inflate scores and make it difficult to detect real effects of hardiness testing for example. Candidates have invested much time and effort to reach this point and this may influence responses. Perhaps future studies could look at completing the LIRS in a more relaxed setting to elicit potentially different and contrasting results. Therefore, the large number of very high response scores on the LIRS can only be assessed to represent high average levels of resilience within the current sample.
This issue indicates a second limitation; in that, the LIRS has been developed with findings from university student samples which may not generalise to other populations. This raises the question of whether experienced military personnel that have been exposed to potentially ‘resilience building’ training and combat can commensurately compare to university students.

Perhaps it is the case that the LIRS is best utilised as a more general measure of resilience, and is not suitable as a SFSC measure due to the potential to fake good; something that might be investigated in future research. Future research using the LIRS may look at these comparisons, towards building normative data for the instrument.

Whilst these findings were not significant and the LIRS appears to lack discriminant validity in SF populations, future LIRS research may investigate the utility of the scale in screening the initial applicant pool, prior to panelling on the SFSC, therefore limiting the effect of group homogeneity. Further, given the importance of studies into resilience in the wider ADF, the LIRS may show utility in non SF individuals for establishing levels of personal resources-based resilience in other military settings, such as for basic recruits or importantly, in the families of military personnel.

**Hypothesis 2: CRT Predictive Validity**

The second hypothesis was that scores on the CRT would predict successful completion of the SFSC. The result showed that CRT scores were significantly different between candidates that passed and those that did not pass; further, logistic regression also showed that CRT scores were predictive of selection outcomes. Therefore, the CRT does show predictive utility for selection of SF personnel in this study. This finding is consistent with previous CRT studies that indicate the test to be a reliable indicator of the thinking disposition of cognitive reflection in decision-making (Frederick, 2005; Campitelli & Gerrans, in press). As far as the author is aware, this is the first time that cognitive reflection
has been tested using psychometric measures in an overseas or Australian SF sample. As such, these findings should be treated as indicative rather than definitive at this time, though they warrant optimism for future studies.

Additionally, the dual-system categories - *System 1* (intuitive) and *System 2* (deliberate) - model of decision making was supported by the findings of this study (Kahneman, 2003; Stanovich & West, 2000, in Frederick, 2005). Firstly, the hypothesis of this study was concerned with *System 2* CRT-R responses (analysis based on correct responses, measuring cognitive reflection) as reported above. Further analysis of the data showed a comparative significant difference in scores on the *System 1* CRT-I responses (analysis based on supplied intuitive responses). The fact that those individuals that passed the course scored significantly lower on the CRT-I than those that did not pass, indicates a dual utility of the CRT. An explanation for this result may be that in fact SF personnel are more likely to use reflective decision-making processes as they require them; whereas, those found not suitable for SF service use intuitive processes (i.e., cannot resist reporting the response that first comes to mind). It may be possible to design future studies in such a manner so as to deliberately measure both CRT-R and CRT-I scores independently as well as to explore any relationship between the two; therefore, informing selection decisions.

Furthermore, consideration may be given to those individuals who obviously attempted to answer the CRT using deliberate processes. For example, those who demonstrably attempted working out on the page towards answering the question correctly, or who appeared to attempt a different answer to the intuitive response. The fact that an individual does not possess the mathematical skills or experience may impact on their ability to answer correctly, but may not be indicative of an inability to think reflectively. In short, the evident dual utility of the CRT may benefit SF screening and selection processes beyond simple right wrong answers.
With regards to the secondary aim of the CRT analysis in this study of examining the CRT as a measure of decision-making ability independent of intellect (see Frederick, 2005), Officers and ORs scores on the CRT were compared. Officers attending the SFSC are nearly all tertiary qualified; ORs however, are historically highly unlikely to be so. The present study found no significant difference in scores on the CRT between the two groups. Whilst acknowledging that education does not equal cognitive ability, the non-significant findings of education in performance on the CRT in this sample may provide insight into the measure as independent of cognitive ability, especially if compared with available cognitive testing done in screening, and therefore warrants future consideration.

Lastly, the current study highlights the CRT’s right/wrong response design potential to offer a means to address self-report criticisms of some psychometric testing, such as faking (see Lords, Bearden, Chen, & Fedak, 2006). Additionally, the CRT potentially offers a more ‘granular’ measure of performance in homogenous groups, alluded to in previous studies of this population (Temby & Drobnjak, 2010). The brief, versatile and easy to administer CRT may represent a significant development in the assessment of decision-making in both screening and selection of potential SF candidates alike, should it be found to be validated in future studies.

One major limitation of the CRT was identified during the study. Items may need to be screened for general familiarity, as the limited number of items (3) may quickly lead to over exposure (awareness) of the answers. For example, the concept of question three in the current study was known to the author and several colleagues as similar to the ‘Test-tube Analogy’ occasionally offered by some scientists in relation to global population growth (e.g.,
see Suzuki, 2009). Continued ‘unique’ question development, screening and security in the future will treat this issue.

It is recommended that the CRT be considered for further studies of this nature, and specifically in Australian SF populations. Overall, these results show that the CRT could contribute unique value and incremental validity to SF selection processes, including screening tools, i.e. future studies may investigate the utility of the test in screening the initial applicant pool. Further, the CRT appears to provide a granular tool that might address the previously noted effect of group homogeneity, as well as faking. Consequently, this study confirms the benefit of continued research into additional valid and reliable psychometric measures, as part of a multi-layered selection process synthesised with other criteria such as cognitive ability, physical fitness and employment specific performance testing (see Beal [2010] study).

**General Implications of the Study Findings**

More generally, the present study results have additional implications. Firstly, both tests may have utility more broadly in the screening/selection protocols for other elite groups; especially as there appears to be limited studies on both tests beyond university students. Secondly, the present study neatly contrasts the difference in a perceived ability to ‘fake good’ on the LIRS, however not on the CRT; therefore, highlighting the need for considered application of psychometric tools of this nature, particularly in higher performing populations.

**Limitations of the Study**

There are several major limitations with this study. Firstly, the lack of a control group in the testing. Due to time constraints and availability, there was no opportunity to gain access to a control group of Regular military personnel not attending the SFSC; therefore, comment

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5 This principle suggests that by starting with only one bacteria in a test tube, and the population doubling every minute for one hour, that at 'one minute to midnight', the test tube would be half full – similar to the premise of Q3- and would be helpful in answering the question if known.
about the population from which the sample has been drawn was not possible. This may have allowed greater discriminatory power of the LIRS in particular, and potentially contributed to normative data for both tests. It is recommended that future studies of this nature consider using control groups from which to compare outcomes.

Secondly, there is a significant lack of data to compare results on the CRT. Although the CRT had a moderately large effect size in predicting outcomes on the SFSC, the small sample size and unequal number of individuals in groups P and NP (for both tests) may have undermined the power of analysis. This limitation may prove difficult to overcome however, as SF sample groups of this nature are uniquely rare in both number and availability (approximately 80 personnel once a year for three weeks). Another limitation of the study is that it continues to remain unclear to what degree cognitive ability in SF populations influences decision-making ability, and potentially levels of resilience. As previously highlighted, Frederick (2005) has shown independence of the CRT in university students, but generalizability of those results to military populations may need more investigation in future studies. Future studies may look at combining cognitive ability testing concurrently to assess this aspect.

The homogeneity of the sample group must be considered to be another limitation. Candidates are all male, have a military background, and prior to the SFSC are screened using a number of psychometric tools including general aptitude tests and personality tests. Further, due to extensive physiological screening, fitness levels of the individuals attending the SFSC are very high, suggesting that they are above average in self-confidence, resilience, self-discipline, and competitiveness (Lepez et al., 2010). Whilst measuring homogenous groups in the selection context is challenging, the findings of the CRT in the present study may go some way towards discriminating with these groups.
A final limitation of this study is that it did not statistically examine those who ‘withdraw-by-own-request’ or those who were removed from the course due to poor performance, both sub-groups of NP. Previous research into the reasons for both withdraw-by-own-request and performance based removal has shown differences between these groups (Beal, 2010; Temby & Drobnjak, 2009); however, these studies were not replicated here due to the current research focus specifically on selection outcomes (i.e., passing or not passing as deemed by the course assessors, not due to medical or voluntary reasons).

**Future Research Considerations**

There are a number of suggestions and considerations around future research highlighted by the present study. Firstly, it would be interesting to employ both of the instruments on future selection courses. There are several SF units within Australia that may present further opportunities to use these tests. Further, tests may be investigated for their utility in the SF screening process, as well as (the CRT in particular) the selection course proper. This would provide comment on those individuals who are screened out and support other screening tools in informing decisions about candidates’ suitability for panelling on subsequent qualification courses.

Another area of interest is whether (cognitively) suitable individuals do not pass due to the predominantly physical nature of the SF selection process. Historically, passing or not passing SF courses has relied heavily on physiological performance (Beal, 2010); therefore, it may be worth investigating how the top ranked performers on psychometric measures compare to those on physiological measures, towards an optimal model of selection. Whilst comment on the makeup of SFSC criteria is outside the scope of this study, SF units themselves may consider the wider use of cognitive and psychological testing, such as the CRT, to attain a more holistic and balanced appreciation of the candidates they are assessing.
Thirdly, the study highlights the need for a well-structured and planned approach to cognitive testing. As demonstrated by the CRT (R & I) cognitive assessment tests may have wider utility than simply pass or fail criteria; analysed by professionals, these tests may allow broader comment on an individual’s potential. Tests such as the CRT may inform future SFSC process design, and at the same time, satisfy desires to lower attrition and costs in SF selection (Temby, 2011). Additionally, given the statistically significant findings on the CRT, this study highlights the future utility of such tests in evaluating similar psychometric measures for selection, through using construct/convergent validity methodology. Beyond contributing to essential developmental and research rigor in test construction, as outlined by Sijtsma (2012), reliable tests offer the ability to validate additional instruments.

With regards to the CRT in particular, it offers a means for treating faking in self-report measures. As candidates are apparently of higher intelligence/aptitude (based on above average cognitive ability thresholds of aforementioned military testing) they may be predisposed to fake on paper psychometric tests (Picano et al., 2002), this may be explored in this population. As previously discussed, there are several options for treating this problem, including ipsative tests and more stringent briefings/consequences, currently being studied (Komar, Brown, Komar, & Robie, 2008; Schmitt & Oswald, 2006).

Lastly, given that these selected SF personnel (group P) still have many months of qualification training ahead of them (12-18 months) before they are ‘officially’ selected, it would be interesting to compare the results of the tests in this present study with those final outcomes at the end of this period. For example, two members of group P scored low on both tests – does this indicate that these individuals may struggle to perform in training beyond selection (outlined by the Beal [2010] study)? This point highlights the potential utility of the tests in providing individuals greater insight of their psychometric qualities, such as decision-

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6 It could be speculated that attrition is a valuable indicator/tool itself, and that relative to a fighter plane, the selection of an SF soldier may be considered very cost effective.
making ability and resilience. That is, results may be able to indicate weaknesses in individuals that can be treated in subsequent training, or debriefed with individuals upon completion or when being removed from the course.

**The Future of Personnel Selection**

Finally, psychometric tests are only one part of possible assessment measures in SF populations. Whilst the present study has highlighted several key benefits and limitations of current and emerging psychometric testing protocols, comment about the utility of biometric measures in personnel selection is impossible to ignore in these discussions (cf. Becker, Cropanzano, & Sanfey, 2011). The use of bio-markers indicates a more holistic approach to assessment, affording greater insight about disposition, temperament, physiology and cognitive functioning. Although questionably relevant to the current study, the increasing awareness of the limitations of papers tests (faking good) and the growing exposure of the content of such tests online (Un-proctored Internet Testing protocols [UIT]; see Macqueen, APS, 2013), raises the issue of other complementary testing approaches. The inclusion of biometric measures to a holistic assessment framework offers great potential in enhancing ‘human capital’ of the organisation.

Biometric measures of individual differences are not new. Previous studies have indicated their utility in establishing discriminant aspects of cognitive ability and personality, including emotional-cortical arousal (Eysenck, 1975); heritability studies in twins (Pedersen, Plomin, McLearn, & Friberg, 1988); and, reticular-cortical and limbic circuit arousal (Briggs, 1989). Currently, numerous research studies support quantitative biometric indicators, such as heart-rate variability, brain activity and physiological response (cortisol and galvanic skin response) as important indicators of both biological and neurological aspects specific to cognitive ability and personality in performance (Akinola, 2010; Becker et al., 2011; Loehlin & Martin, 2001; Senior, Lee, & Butler, 2011; Wright, Cropanzano, Bonnett, & Diamond,
Further, techniques such as EEG and fMRI have also shown promise in suggesting links between brain function and specific attributes such as leadership, decision-making and strategy formation (Klein & D'Esposito, 2007; Waldman, Balthazard, & Peterson, 2011). For example, Deary (2012) provides evidence that the brain works more effectively and efficiently in those achieving higher intelligence test scores. Considered as somewhat controversial (e.g., linking personality and psychopathology, and intelligence and criminality [Dennet, 2013]), these studies not only heed caution to ‘hasten slowly’ around ethical concerns, but may offer a significant complimentary effect to psychometric tests such as the LIRS and CRT in the future. Particularly when considering the testing specificity challenges presented by homogenous samples.

Studies of various bio-markers are currently being designed for use in ADF populations to examine psycho-physiological responses to acute stress, or, markers of resilience (e.g., Assoc. Prof. Nalivaiko et al., UNSW). Similarly, heart rate variability in behaviour (decision-making) is currently of interest to DSTO researchers working for Special Operations Command, Australia. Additionally, research partnerships between US and UK SF units are exploring the combined power of biometric and psychometric measures to indicate individual differences (see BlackGhost bio-tracking, Equivital website).

Whilst outside the remit of the current study, this final note is considered relevant by the author in that, readers of this paper and subsequent users of the findings reported herein, will be more completely informed when considering any implications or limitations in future research, particularly for those interested in SF populations. It could be reasonably suggested that cognitive ability and personality testing are about to undergo a similar paradigm shift in development to that of almost exactly 100 years ago, when the first recognised paper psychometric tests were being employed by Alfred Binet. Used in synthesis with
psychometric tests, such as the LIRS and CRT, biometric indicators may offer the next quantum step in measuring individual differences for personnel selection protocols.

**Conclusion**

The development of future protocols to be used in the selection of SF soldiers must be evidence based. Previous research has shown the value of psychometric tests, beyond traditional intelligence and personality, in predicting outcomes on SFSC; however, further research will continue to identify more accurate and relevant tools in selection which can improve the efficiency and effectiveness of the processes. The purpose of this study has been to assess the utility of the LIRS and the CRT for their utility in predicting candidates’ outcome on a SFSC. The results indicated that the CRT may have predictive qualities, and therefore, it appears that successful individuals are higher in reflective decision-making than those who were not successful. The LIRS did not show a predictive utility, as there was no difference in levels of resilience across the groups; indeed, all candidates appear to be very high in resilience as measured by the scale. Importantly, with regards to the CRT this is the first known study to test decision-making in an Australian SF selection context.

Overall, the results from this study are positive and suggest further areas for research in the future. These results are not only important to informing selection and screening decisions, but will contribute to the limited research in this area. The CRT in particular is recommended for use in future SFSC, and therefore contributing to filling gaps in understanding in this field, such as, the identification and measurement of additional specific personal attributes unique to selecting SF soldiers, including resilience and decision-making ability.

Organisations are increasingly aware of the utility of such predictive tools for selection, particularly in elite groups. The continued long association between psychometric testing protocols and the military will inform the development of such processes influencing
the broader field of organisational recruitment. The ability to identify suitable individuals for occupational environments where specific specialised skills, knowledge and abilities are required, will allow organisations to realise the performance and cost benefits of selecting and training suitable individuals and will improve both human and organisational performance generally.
References


*Multivariate Behavioral Research*, 37, 4-20.

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Appendix A: Lifespan Individual Resilience Scale

**Lifespan Individual Resilience Scale**

Age ________ (years of age)

Instructions: To what extent do you or disagree (1) or agree (7) with these statements (please circle your answer)

<table>
<thead>
<tr>
<th></th>
<th>Strongly Disagree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>I achieve what I set out to do.</td>
<td>1 2 3 4 5 6 7</td>
</tr>
<tr>
<td>2.</td>
<td>I feel that that I belong with my friends.</td>
<td>1 2 3 4 5 6 7</td>
</tr>
<tr>
<td>3.</td>
<td>My family are a source of strength for me.</td>
<td>1 2 3 4 5 6 7</td>
</tr>
<tr>
<td>4.</td>
<td>I feel accepted by my family.</td>
<td>1 2 3 4 5 6 7</td>
</tr>
<tr>
<td>5.</td>
<td>I have a good idea of what is important to me.</td>
<td>1 2 3 4 5 6 7</td>
</tr>
<tr>
<td>6.</td>
<td>My friends look after me.</td>
<td>1 2 3 4 5 6 7</td>
</tr>
<tr>
<td>7.</td>
<td>I know that my family would help me if I needed help.</td>
<td>1 2 3 4 5 6 7</td>
</tr>
<tr>
<td>8.</td>
<td>I feel that I can influence what happens to me.</td>
<td>1 2 3 4 5 6 7</td>
</tr>
<tr>
<td>9.</td>
<td>My friends are a great source of support.</td>
<td>1 2 3 4 5 6 7</td>
</tr>
<tr>
<td>10.</td>
<td>When I think about my future, I feel positive.</td>
<td>1 2 3 4 5 6 7</td>
</tr>
<tr>
<td>11.</td>
<td>I can rely on my friends for help if I needed it.</td>
<td>1 2 3 4 5 6 7</td>
</tr>
<tr>
<td>12.</td>
<td>I feel safe within my family.</td>
<td>1 2 3 4 5 6 7</td>
</tr>
</tbody>
</table>
Appendix B: Cognitive Reflection Test

Cognitive Reflection Test

Taken from Frederick (2005), this test is composed of three questions as follows:

(a) A bat and a ball cost $1.10 in total. The bat costs a dollar more than the ball. How much does the ball cost? ____ cents

(b) If it takes 5 machines 5 min to make 5 widgets, how long would it take 100 machines to make 100 widgets? ____ min

(c) In a lake, there is a patch of lily pads. Every day, the patch doubles in size. If it takes 48 days for the patch to cover the entire lake, how long would it take for the patch to cover half of the lake? ____ days
Title of the Project:
An Examination of Psychometric Testing for Special Forces Personnel

Researchers Contact Details:
Chief Investigator: SGT Anthony Moffitt – 0439 552 318
Primary Supervisors: A/Prof. Julie Ann Pooley – (61 8) 6304 5591
Dr. Guillermo Campitelli – (61 8) 6304 5521

This research project is being undertaken as part of the requirements of an Honours Thesis at Edith Cowan University.

Sources of Funding:
All funding for the research will be provided by the Chief Investigator. Amenities in which testing will be conducted are provided by SASR with permission by the Commanding Officer.

Description of the Research Project:
This research offers a quantitative design to explore the potential of several psychological variables (resilience, cognitive reflection and openness to experience) as predictors of an individual’s likelihood of passing a rigorous Special Forces selection process.
You have been selected to participate in this testing by virtue of your candidacy on the 2013 SASR Selection Course.
You are being asked to complete all questions in the three test booklet accompanying this information sheet. It is expected that you should finish this task within the one hour time permitted.

As your involvement is voluntary, if you choose not to participate please indicate so to the test supervisor. Similarly, if you experience any discomfort or inconvenience at any time please indicate to this effect.

Positive outcomes from this research include more effective, efficient and sensitive models of selection for use in the wider military and societal context, and will inform future study and training in this area.

If you choose to participate please read and sign the accompanying consent form and listen to directions from the testing supervisor.

Confidentiality:

The information you supply will be collected and analysed in line with the above outcomes. On completion of the tests, they will be collected, de-personalised and recoded into raw data with no connection to the participant. Analysis will occur after the completion of the Selection Course. The Chief Investigator and research team will at no stage be able to make any personal connection between candidates and their results. Any information connecting candidates to the data will be destroyed by the testing supervisor – a Registered Army Psychologist.

Results:

Upon completion of the study all information will be published in a report and be available by application. No names of participants or any personal reference to individuals will be included.

Voluntary Participation:
Participation is voluntary. Any decision not to participate will not impact negatively on your candidacy on the Selection Course, nor will it impact negatively on your career in the Australian Defence Force. Upon commencing the testing, if at any time you reconsider participation, you are free to withdraw.

If you have any questions or require any further information about the research project, please contact one of the above Researchers.

Alternatively you can contact the Australian Defence Force or Edith Cowan University Research Ethics Officer.

If you have any concerns or complaints about the research project and wish to talk to an independent person, you may contact:

Research Ethics Officer
Edith Cowan University
270 Joondalup Drive
JOONDALUP WA 6027
Phone: (08) 6304 2170
Email: research.ethics@ecu.edu.au

The following testing has been approved by both the Australian Defence Force and Edith Cowan University Human Research Ethics Committees.

Thank you for your time.

Anthony Moffitt.

SGT
Australian Defence Force - Army
0439 552 318
Appendix D: Consent Form

CONSENT FORM

The following series of tests are for research purposes only and are designed to test their utility in recruiting potential candidates for Special Forces Selection Courses. As such, the researcher asks that you attempt all questions openly and honestly in line with testing data you have already supplied.

It is important that you understand that no element of any of the results of this testing will be used in the decision process for selection. Assessing staff will not have access to or sight of these results. Upon completion the data will be de-identified and recoded for analysis purposes, without reference to you personally.

Please complete the following test within the 1 hour allowed. Once you are satisfied that you have answered all of the questions please hand it to the supervisor.

1. I have been provided with information explaining the research project and I understand its intent.

2. I have been given the opportunity to ask questions and all my questions have been answered satisfactorily.

3. I am aware that I can contact the researcher or their supervisor if I have any further queries, or if I have concerns or complaints. I have been given their contact details in the Information Letter.
4. I understand that participating in this project will involve completing a written test of approximately 80 questions.

5. I understand that the researcher will not be able to identify me and that all the information I give will be de-identified, recoded and kept confidential and will be accessed only by the researcher and his/her supervisor.

6. I am aware that the information collected during this research will be stored in a locked cabinet at ECU for 5 years after the completion of the project and will be destroyed after that time.

7. I understand that I will not be identified in any report, thesis, or presentation of the results of this research.

8. I understand that I can withdraw from the research at any time without penalty.

9. I understand that I will not be formally de-briefed on the result of this testing; however, I will be able to access the written report relating to this study upon completion.

10. I freely agree to participate in this project.

NAME: ____________________________________________

SIGNATURE: ___________________________ DATE: ___________