
# Exploring Criminal Capacity in terms of Executive Control Function and Emotional Intelligence:
# An Investigation within the South African Youth Male Population of Gauteng

Research report submitted in partial fulfilment of the requirements of the degree Masters in Social and Psychological Research (MASPR) at the University of the Witwatersrand.

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## Abstract

The law tests the criminal capacity of children as a cold cognitive component (i.e. the capability of successful mediation of emotional responsiveness to a scenario), but this does not align with current neurocognitive findings. The law assumes criminal capacity is based on adult-like Executive Control Functions (ECF) and adequate level of emotional intelligence (EI), due to a sufficiently matured brain. However, neurocognitive findings indicate variability in the rate of physiological maturation of the prefrontal cortex of adolescents, which may result in ineffective mediation of ECF and emotional responsiveness (i.e. hot cognition). This study presents the results of a quantitative study directed at an exploration of ECF and EI from two groups of boys, aged 14-17 years. A target group (N=42) of adolescents found to be in contravention of the law, and the comparison group (N=64) not in contravention with the law. ECF was measured using the Wisconsin Card Sorting Test, Tower of London and Stroop Colour Word. The EI of the participants was measured using the Schutte Emotional Intelligence Scale. Results compared developmental trends of ECF and EI between the two sample groups, as well as the difference in development between each age group within the sample groups. Findings of the empirical study confirm that youth in conflict with the law are more at risk for responsiveness guided by hot cognition due to low understanding (concept formation) and low consequential thought; exacerbated by their inability to effectively manage emotions or to utilise them in times of need.



*Keywords: Child Criminal Capacity, Executive Control Functions, Emotional Intelligence, Neurocognitive, Adolescent Male Criminals,*

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# Chapter 1: Introduction, Research Aims, Rationale

## 1.1 Introduction and Problem Statement

The number of youth accused of serious crimes is at a constant rise in South Africa (RSA) (Kramers-Olen, 2015; Pillay & Willows, 2015). Adding to the concern is the current dialogue in psychology regarding the definition and legal parameters which sentence a young individual as a criminal based on their 'confirmed' capacity to commit a crime (Schoeman, 2016; Skelton & Badenhorst, 2011). The abovementioned concern is viewed as a problem, or one of the perceived 'gaps' in the application of the Child Justice Act No. 75 of 2008, as identified by psychology consultants within the legal field, as there is the lack of a set mental-health definition for criminal capacity which can assist psychologists with their assessments (Pillay & Willows, 2015).

In RSA, criminal capacity is currently described as a mixture of two components, namely the cognitive component and a moral component (Pillay & Willows, 2015). Previous studies conducted, which focussed on the cognitive component of criminal capacity, indicated that variations in Executive Control Functions (ECF) were the latent variables underpinning decision making with regards to criminal capacity (Crone, 2014; Maoz & Yafe, 2014; Moll, Zahn, de Oliveira-Souza, Krueger, & Grafman, 2005; Rosenbloom, Schmahmann, & Price, 2012; Steinberg, 2005; Van den Bos, 2007). Additionally, studies exploring criminal capacity within the context of moral motivations have concluded that all moral motivations are a result of both cognitive and emotional influences and/or development (Adesegha, 2015; Congdon & Canli, 2008; Kramers-Olen, 2015; Steinberg, 2005; Van den Bos, 2007). Specifying moral motivations in terms of the brain structure and its functions, research indicated that moral motivations which are correctly acted on are the result of the effective mediation of subcortical structures (underpinning emotional instigation, or in this study ) by the maturing frontal lobe functions (which are responsible for ECF, also known as a higher-order cognitive function) (Adesegha, 2015; Congdon & Canli, 2008; Kramers-Olen, 2015; Steinberg, 2005).

Adding to the abovementioned, ongoing research suggests that children have a continuously developing brain structure still undergoing physiological maturation till a few years past adolescence (Adesegha,

2015; Congdon & Canli, 2008; Kramers-Olen, 2015; Steinberg, 2005). Due to the executive control functions (ECF) structures still maturing, there is an implication that children and adolescents cannot sufficiently mediate their subcortical responses and react due to overwhelming emotional surge (Kramers-Olen, 2015; Steinberg, 2005). This process of insufficient mediation of emotional responses is defined as hot cognition (Kramers-Olen, 2015). Comparatively, criminal law tests for criminal capacity with the assumption that an adolescent has a 'sufficiently' matured frontal lobe, as such assuming the adolescent acted in contravention of the law through controlled decision making (i.e. by choice) and with their emotions successfully mediated by their ECF (Child Justice Act, 2008). The process involving intact ECF, where a person is able to make a calculated decision without being affected by overwhelming emotions, is defined as cold cognition (Steinberg, 2005; Van den Bos, 2007). However, although the abovementioned neurological findings of the adolescent brain's structural maturation imply hot cognition in decision-making (Kramers-Olen, 2015; Steinberg, 2005), the neurocognitive functioning of youth in conflict with the law in terms of executive control and emotional intelligence (a requirement for motivation) had yet to be explored empirically within the South African population (read Schoeman, 2016 for more details regarding current RSA research on the topic).

This study was conducted as an empirically-based research for exploring criminal capacity in RSA by comparing the cognitive skills and level of emotional intelligence (EI) present in convicted youth. For operationalisation purposes, criminal capacity was defined under the umbrella of cognitive control functions and emotional intelligence and was investigated as a relation to implied hot cognition in adolescents. (i.e. the individual is not able to effectively control his or her emotional responses or tends to respond using impulsivity). To conduct this study empirically, the focus was solely based on the neurocognitive skills used by the two comparative samples where participants within the same age-groups are used to compare findings between the two samples. Therefore, motivation and its influence on criminal capacity were assessed within the study as it broadens the scope and focus of the study towards additional environmental influences. Furthermore, as the study focussed on the neurological components underlying criminal capacity, the African perspective pertaining to behaviour and moral decision-making was not investigated as its scope falls beyond the boundary of the study and shifts the

underlying focus to towards the influences of motivation as a component of criminal capacity. However, the study did consider the demographic background of participants in terms of known risk factors affecting the neurological basis of criminal capacity and to confirm any significant differences in those factors which need to be considered for testing purposes in the future.

The present study had aimed to investigate if young males between the ages of 14 and 17 who had been in contravention with the law have a lesser capacity for executive control functions than young males aged 14 to 17 from a similar demographic who had not been convicted of, or caught in suspicion of, a crime. The study also compared the level of EI between the two comparative groups and viewed the EI developmental trends within each sample group. Findings of the EI assessment were used as an indicator of insight regarding socially acceptable behaviour.

The entire assessment comprised of a demographic questionnaire and a computer-based cognitive test battery. The results were analysed to provide insight on the maturation of ECF, the level or pattern of ECF skills used, and the current level of EI in the two samples. It is hoped that this research will provide empirical evidence that can be tentatively used to gain insight about the directionality of future research regarding criminal capacity in RSA.

For this study, the words child, youth and adolescent are used interchangeably when identifying the individuals of interest. Young individuals are referred to as a child when citing from references within the legislative context, they are referred to adolescent when discussing the neuroscientific findings and developmental theories, and they are referred to as youth (a collective term for the samples) while discussing the design of the study.

### 1.2 Rationale

Ongoing research in RSA (Kramers-Olen, 2015; Pillay & Willows, 2015), which focuses on the maturation of adolescent frontal lobe and its effect on criminal capacity, implied the possibility of adolescents reacting to situations using hot cognition (i.e., ineffective mediation of the ECF and its effect on EI). Additionally, due to neurocognitive findings in the abovementioned studies, it is known

that adolescents differ in cognitive functions from adults; however, recent publications seemed to lack empirical research on criminal capacity in relation to the maturation path of ECF and EI of RSA youth (read the following for more information on current findings: Kramers-Olen, 2015; Pillay, 2015; Pillay & Willows, 2015; Schoeman, 2016; Skelton & Badenhorst, 2011).

The current study was proposed as it would be one of the first studies conducted in RSA exploring the convicted adolescents' level of ECF and EI compared to adolescent males not convicted for a crime. As such, the rationale for the present study was that it would be one of the first research reports to empirically explore criminal capacity in terms of ECF and EI to examine the presence of implied hot cognition through the current EI level and ECF skills used by each sample respectively. An additional rationale of the study was it considered the future direction of using the empirical results of this research tentatively as a guideline or direction in informing legal practice when testing for criminal capacity or to provide further insight on how to design the divergent programmes to assist the convicted youth in the effective reintegration into society. For further information on proposed future directions, please refer to Chapter 6.

### 1.3 Research Aims

The purpose of the study was to compare findings of the demographic profile, frontal lobe executive control function (ECF) and emotional intelligence (EI) in young males of Gauteng between the ages of 14 to 17. The research compared results of comparative sample groups (i.e. young males who have been caught for being in contravention to the law and the comparative group of young males who have not been convicted of, nor caught in suspicion of, a crime). The study collected data using a computer-based test battery (comprising of three neurocognitive tests and an EI self-report measure) and a demographic questionnaire.

The study aimed to compare the age-related trends of ECF skills and EI between the two sample groups, as well as using descriptive methods to explore any differences in ECF and EI developed between sample groups.

## Chapter 2: Literature on Criminal Capacity in RSA and the Argument in Neuroscience

To understand the direction of the argument and the research, it is important to know the related laws passed in legislation and capacity. The following chapter explains the basic legislation laws of the Child Justice Act, thereafter outlining issues arising in psychological practice of the abovementioned laws. After the reader has been familiarised with the issues and the laws, criminal capacity will be defined in terms of cognitive development, substantiating the definition with empirical findings in neuroscience over recent years.

### 2.1 Criminal Capacity in RSA

The following literature argument was written in the context of the Child Justice Act (Act 75 of 2008), which is still the legislative Act in use for current practice. However, the researcher is aware of the *Child Justice Amendment Bill* ("*Child Justice Amendment Bill Sent for Assent"*, 2019), and its proposed amendments to the issues raised in *Section 2.1.2 (*below), among other concerns. As the amendment has not yet been approved, and the aim of the research was to focus more of the testing of the ECF and EI; the researcher chose to contextualise this study's literature background according to the current legislative practice based on the Child Justice Act of 2008.

#### 2.1.1 Understanding the Child Justice Act No.75 of 2008.

According to the Child Justice Act (Act 75 of 2008) of South Africa, section 11(1) (2008; hereafter referred to as the Act), a child is considered to have criminal capacity if he/she was capable of *appreciating* the wrongfulness of his/her actions *and* conducted him/herself "in accordance with this appreciation of the wrongfulness of such actions" (Child Justice Act, 2008). This law follows the general M'Naghten assumption, known to almost all legal systems in the world, that punishment will be morally justified if the defendant was capable of choosing whether to do wrong at the time of the act (Penney, 2012). Therefore, the law not only states that a child must be held *responsible* for his/her actions (Kramers-Olen, 2015; Schoeman, 2016; Skelton & Badenhorst, 2011) but also conditions the ability and maturity (Schoeman, 2016) for moral blameworthiness be present (Kramers-Olen, 2015).

Thus, in essence, the Act states that to be responsible and to be blameworthy, a child needs to have the maturity to control his actions and the ability to have insight on socially acceptable behaviour.

Furthermore, the legislation has defined two minimum ages under which a child is deemed to have criminal capacity (Pillay, 2015). The first age of capacity is known as the *absolute minimum age*, which is the age of 10 years old (Pillay, 2015). The Act specifies that all children under the age of 10 are conclusively deemed to lack capacity and so cannot be prosecuted for any crime (Child Justice Act, 2008). The second age set by the Act (2008), referred to as the *minimum age of capacity* by Schoeman (2016), is at 14 years old. According to the Act (2008), all defendants from the age of 14 are considered to have criminal capacity (i.e., the cognitive ability and maturity) to make the distinction between right and wrong and act in accordance to that understanding (Child Justice Act, 2008).

The age gap between 10 to 14 years is noted as the *doli incapax* (Child Justice Act, 2008). The presumption of the *doli incapax* states that an "average or normal child" (Skelton & Badenhorst, 2011, p. 22) older than 10, but younger than 14, cannot be held liable for an offence. However, should exceptional cases appear, in which a child is thought to be more mature than the average in *both* the cognitive and conative components, then capacity needs to be proven without reasonable doubt (Child Justice Act, 2008). The conative component is then recognised as the behaviour element that constitutes free will leading from the cognitive skills to action (Pillay, 2015). Therefore, children assumed to meet the *doli incapax* presumption will need to be evaluated to prove that not only are they more mature than the average child (Skelton & Badenhorst, 2011), but that they also committed the criminal act of their own free will (i.e., choosing to do wrong), and thus can be held liable.

Offenders are expected to be evaluated by probation officers within the first 48 hours from when the offence was committed, or when the offender was caught (Schoeman, 2016; Skelton & Badenhorst, 2011). Probation officers are required to use the criminal capacity test provided in section 11(1) of the Act to evaluate the criminal capacity of offenders. However, the test provided is very vague and assesses only generalised knowledge of right and wrong (Skelton & Badenhorst; 2011). Although the Act also stipulates that capacity should be assessed in the domains of cognitive, moral, emotional, psychological

and social development (Child Justice Act 2008), probation officers are not obligated to conduct evaluations in these areas (Pillay, 2015; Pillay & Willows, 2015; Schoeman, 2016). Instead, psychologists are approached to become expert witnesses in the case and to assist the court in making a judgement call based on their evaluation on the above-mentioned domains of development (Kramers-Olen, 2015; Pillay, 2015; Schoeman, 2016). Within the stipulation of the cognitive and social development, prosecutors are expected to consider the education level of the child as well as the domestic and environmental circumstances that may contribute as risk factors and impact the maturity of the child (Skelton & Badenhorst, 2011). However, problems arise in evaluating criminal capacity as probation officers are obligated to express their opinion on the child's capacity, as well as to "prove" capacity, despite lacking the proper assessment tools and possible training in areas assessing development (Schoeman, 2016).

Although there are issues, which will be elaborated on later in this dissertation, in the assessment practices of criminal capacity, the advantage of the *doli incapax* system is that it not only requires psychologists as expert witnesses but has also led to the creation of a structure whereby all children under the age of 14 years are automatically protected from prosecution by the law (Schoeman, 2016). The Act (2008) stipulates that all children under the age of 14 years may face non-punitive measures and diversion. Moreover, there has been a further proposal by legislation, indicating that after an initial investigation by probationers, if found to have criminal capacity, children below 18 years old will be deemed *responsible, but not blameworthy* and will receive rehabilitation and treatment to assist their reintegration into society (Kramers-Olen, 2015). The justice system aims to push for diversion wherever possible, in the hope that the needs-directed rehabilitation will disrupt the pattern of criminal behaviour that arises in offenders prosecuted by the law (Adesegha, 2015; Lamb & Sim, 2013; Schoeman, 2016).

However, it should also be noted that by fixing the absolute minimum age of capacity at 10 years, RSA fails to comply with the guidelines set in General Comment 10 by the UN Committee on the Rights of Children (CRC), suggesting to set the absolute minimum age of capacity at 12 years (Kramers-Olen, 2015; Pillay, 2015; Schoeman, 2016; Skelton & Badenhorst, 2011). The UN considers any minimum age lower than 12 unacceptable (Skelton & Badenhorst, 2011), and encourages all countries to aim for

a higher minimum age of between 14 to 16 years (Kramers-Olen, 2015; Pillay, 2015; Pillay & Willows, 2015). Although the UN guidelines are not constituted as binding international law, they do play a significant role in the protection of young offenders (Skelton & Badenhorst, 2011). RSA justifies its lack of compliance with the UN standards as being due to a lack of reliable statistics on accused child criminals between the ages of 10 to 13 years (Skelton & Badenhorst, 2011). This justification is a cause for concern regarding how RSA deals with its child offenders, and may further be an indication of how it fails to comply with the rule set out to protect its young population.

Therefore, the Act is founded on the conceptualisation of responsibility and blameworthiness in children under capacity. Unfortunately, RSA's legislation provides vague criminal capacity tests to be used by probationers to assess for capacity. Extensive developmental tests are only to be utilised by psychologists, who appear in court as expert witnesses. Moreover, true to its stance of protecting children, the legislation requires that most child criminal cases (to be referred to as youth convicts or youth in conflict with the law from here on) be diverted into rehabilitation so that they may be protected from having a criminal record and also to help reintegrate them into society. However, concerns are raised that psychologists who are required to test for capacity may experience limitations in applying their skills due to the perceived gaps in legislation on the topic of age, testing and definition of capacity (Adesegha, 2015; Kramers-Olen, 2015; Pillay, 2015; Pillay & Willows, 2015; Schoeman, 2016). It is indicated that these gaps may raise questions or is0sues that may fall outside their expertise (Adesegha, 2015).

### 2.1.2 Gaps in the application of the Child Justice Act.

Complexities in expert psychological opinion for criminal capacity is complicated. These complexities arise relative to conflicting comprehension of the environmentally expectant approach held by the legal system (Pillay, 2015; Schoeman, 2016) and the environmentally-dependent understanding integral to the human sciences (Pillay & Willows, 2015). The argument is that cognitive and socioemotional development is a slow maturation process and it cannot be synchronised accurately to a definitive age, thus making it difficult to conclude on a specific chronological age for capacity (Skelton & Badenhorst,

2011; Woolard et al., 1996). Credibility is given to the argument because of neuroscientific findings – highlighted by Adesegha (2015), Crone (2014), Kramers-Olen (2015) and various other scholars – regarding the anatomy and functioning of the adolescent brain. The neuroscientific findings, which will be discussed later, lead to the debate by psychologists that age limits will be arbitrary unless "accompanied by an element of flexibility" regarding developmental capacity (Skelton & Badenhorst, 2011 p. 5).

The second issue for psychologists regards the definition of capacity itself. Pillay and Willows (2015) indicate that although psychologists are requested to test for 'criminal capacity', the term itself is a legal one with no direct or alternative definitions. As noted above, the term consists of a cognitive and a conative component. The cognitive component indicates an expectation of the child's 'knowledge' between right and wrong, as well as the appreciation of that knowledge. The conative component relates to the action that takes place in appreciation of that knowledge (Pillay & Willows, 2015). However, the argument posited by a mental health practitioner is that it would be rare for one to find a child over 10 years of age "lacking in [the] capacity to tell right from wrong" (Skelton & Badenhorst, 2011, p. 47). Furthermore, there is also an awareness in the field that even if a child is capable of knowing right from wrong, it does not necessarily indicate an appreciation or understanding of the concept (Pillay & Willows, 2015), nor does it indicate the capability to engage in it (Schoeman, 2016).

A lack of definition for mental health practice may lead to ethical uncertainty for psychologists who are approached as expert witnesses. When approached, a psychologist's role stretches out of their original scope to that of a neuropsychologist or a forensic psychologist; both specialisation categories that were only recognised as of 2012 by the Health Professions Council of South Africa (HPCSA; Health Professions Act, 56 of 1974, 2011). Despite the 2012 promulgation of a category for forensic psychologists, registration within the category remains unresolved. This leaves the legal profession confused as to whose scope of practice an assessment of clinical capacity belongs to. Truter, Mazabow, Morlett Paredes, Rivera, and Arango-Lasprilla (2017) posit that the HPCSA allows registered clinical and educational psychologists to practice as neuropsychologists, without additional tertiary training. Secondly, psychologists cannot test for the conative component as there is no standardised, valid or

reliable test that can assess a child's ability to act in accordance with the law (Pillay, 2015). Thirdly, even though the cognitive component can be tested, there is no uniform model of the measures to be used, thus leading to a lack of standardised outcomes (Pillay & Willows, 2015; Skelton & Badenhorst, 2011). Accordingly, the lack of a definition for the cognitive parameters that need to be tested leaves each psychologist to assess criminal capacity according to his/her understanding of the cognitive skills used. Lastly, legal professionals focus on the 'moral' component of capacity, which is unspecific in definition and is a strong determinant in assessing for an individual's capacity to determine right from wrong. The issue arises again for the component as there is no standardised way to determine moral development that would be nationally or culturally relevant in this diverse country (Kramers-Olen, 2015; Pillay & Willows, 2015). Consequently, the legal requirements and definition of capacity may be considered above and beyond the scope of a mental health practitioner's expertise (Adesegha, 2015; Pillay & Willows, 2015), and may violate the ethical rules of just and fair research practices (Form 223 – Ethical Rules of Conduct, 2013).

Limitations are placed with testing due to the obvious lack of trained mental health professionals in the country (Penney, 2012; Pillay & Willows, 2015; Schoeman, 2016; Truter et al., 2017). This is exacerbated by a lack of RSA norms across the diverse cultures in the country as well as the subsequent lack of standardised, valid and reliable measures (Kramers-Olen, 2015; Schoeman, 2016; Skelton & Badenhorst, 2011; Truter et al., 2017). It should be noted that although various consequences may arise from a lack of mental health professionals in RSA, the discussion is beyond the scope of this study. However, a critical point to note is that a lack of normative data greatly limits the use of neuropsychological instruments (Skelton & Badenhorst, 2011; Truter et al., 2017).

In general, the gaps in the application of capacity for mental health practitioners can be summed into three major areas, namely: youth offender age of capacity, the definition of capacity and RSA norms; all of which affect testing. Given the argument in the literature, the easiest definition of capacity, to begin with, would be according to its cognitive component; as there are known reliable measures for it. The hiccup occurs when there is no set understanding of which cognitive skills to test and a lack of

norms. Thus, justifying this research to define capacity in terms of cognitive skills, which make up the executive function (EF) and to test for norms.

### 2.1.3 Acknowledging risk factors.

Though the argument above has been limited to the application of testing for capacity to a cognitive level – based on the requirements of the Act and the limitations faced by mental health professionals – it is necessary to acknowledge that cognitive development is not the sole determinant of capacity. Developmental factors are known to play a role in how individuals behave in legal contexts (Lamb & Sim, 2013). It is argued that variation in psychosocial factors such as family, caretakers, culture, socio-economic status, neighbourhood, education and schooling, as well as certain biological factors, impact the level of maturity of the child as well as life experience (Bartol & Bartol, 2014; Bezuidenhout 2013; Schoeman, 2016). Furthermore, the argument posits that the impact of the psychosocial factors on behaviour is situational and not definitive (Woolard et al., 1996). Considering the study's primary focus directed towards cognitive skills relating to EF and hot cognition, the arguments regarding developmental factors will not be discussed in depth. However, risk factors cannot be excluded completely from the study, thus they will be accounted for as extraneous variables using a questionnaire.

## 2.2 Understanding Criminal Capacity in Terms of Cognition

According to the legislation, for a criminal act to be committed, an individual must engage in a decision-making process of right and wrong (Schoeman, 2016). Thus, to understand criminal capacity, in relation to cognitive maturation, requires an understanding of the process of decision-making. Decision-making is a complex ECF that "draws on past experiences" to meet present goals while anticipating the outcome (Rosenbloom et al., 2012, p. 266). Furthermore, decision-making is influenced by an individual's underpinning emotional perspective and cultural context (Rosenbloom et al., 2012).

The following section aims to discuss decision-making as an EF skill influenced by an individual's ability for cognitive control. To contextualise criminal capacity in terms of cognitive maturation, it will be explored as an effective mediation of ECF in decision making. For this study, cognitive maturation,

generally defined as a process of development, where an individual matures or reaches full higher cognitive control, will express cognitive development as the results of physiological maturation and socio-emotional experiences ("What Is Maturation in Psychology?", 2018).

### 2.2.1 Executive control function: An umbrella term.

The term ECF is used to defined complex cognitive processes that organise and order an individual's behaviour (Nugent, 2013a) to achieve a particular goal (Zeki, Goodenough, Baird & Fugelsang , 2004). A consistent observation regarding the development of cognitive capacities across childhood and adolescence is the rapid increase in EFs, also known as cognitive control functions (Bari & Robbins, 2013; Crone, 2014). Therefore, as children mature into adolescents, cognitive control functions, such as working memory, response inhibition, adaptive control, and complex reasoning gradually increase due to the maturing brain structure (Crone, 2014).

The abovementioned cognitive sub-processes, which are encompassed by the term executive control function, flexibly coordinate their functions to achieve a set goal (Zeki et al., 2004). Furthermore, the cognitive sub-processes function in a hierarchal manner, where simple cognitive sub-processes (e.g., working memory, inhibition and adaptation) function together to form a basis for the complex cognitive processes (e.g., relational reasoning and creativity) when an individual engages in decision-making (Crone, 2014).

Working memory is a multi-component cognitive skill working with short-term or active memory, wherein an individual's mind uses the cognitive skill to actively hold and manipulate temporary data in the mind (Nugent, 2013b). Thus, during the task of decision-making, working memory helps an individual to process and manipulate specific verbal and/or visual stimuli, which caught their attention (Nugent, 2013b), to assess for possible outcomes. Inhibition is a complex cognitive control function which can be divided into two functional components (i.e. attentional inhibition and response inhibition) (Tiego,Testa, Bellgrove, Pantelis & Whittle , 2018). Attentional inhibition is defined as the cognitive ability to resist the interfering effects of distracting stimuli (i.e. this component is important for interference suppression and attentional control) (Tiego et al., 2018). Comparatively, response

inhibition is defined as the ability to suppress or restrain inappropriate responses (Crone, 2014) in terms of behavioural processes, impulses, or desires (Inhibit, 2007), as such it is also referred to as behavioural inhibition (Tiego et al., 2018). Therefore, response inhibition restrains an individual from behaving on an impulsive desire before or during the decision-making process. However, despite their different functions, both working memory and response inhibition can be tested by implementing specific task rules (Crone, 2014). Furthermore, the ability to adjust one's behaviour as a response to a change in task demands is referred to as adaptive control (Crone, 2014), more commonly termed as a shift in mental set (Coulacoglou & Saklofske, 2017). Therefore, any perceived change in circumstances from feedback cues may lead one to adjust according to the new context to make the correct decision. Overall, the simple cognitive processes function as a flexible unit to interpret incoming data, suppress any impulsive reactions and to finally assess for possible outcomes appropriate to the changed context.

According to Crone (2014), complex cognitive processes provide an individual with the ability to use multiple perspectives when interpreting problems, as they enable an individual to be capable of integrating knowledge or inferring solutions from presently available information. An example is the process of creativity, whereby multiple dimensions of information are integrated to provide novel and pragmatic solutions to problems (Crone, 2014).

Additionally, there is the process of relational reasoning (also known as consequential thought), which is the ability to "imagine alternative outcomes and understand the consequences of those outcomes" (Zeki et al., 2004, p. 1797). A more in-depth interpretation of consequential thought would be an understanding that an individual can manipulate the imagined set of circumstances leading to an event and judge the extent to which certain mutations could lead to alternative outcomes. Hence, one can understand that using consequential thought during decision-making requires not only "the generation of appropriate alternative courses of action, but also the ability to sort through and decide which behaviours would result in the appropriate outcome, and which would not" (Zeki et al., 2004, p. 1798). A point to note, however, is that the ability to engage in different strategies of problem-solving is a result of the developmental and maturational differences in brain activation (Crone, 2014; Zeki et al., 2004).

Overall, decision-making involves various cognitive processes that are considered aspects of executive control function. These cognitive processes progress as the individual matures with age and experience, consequently progressing the development of executive control functions responsible for decision-making. Thus, this increases the ability of relational reasoning – a cognitive process considered necessary when assessing for criminal responsibility.

### 2.2.2 Criminal responsibility: A result of consequential thought?

The legislation focuses on cognitive and moral development underlying criminal capacity in relation to the work of developmental theorists, Kohlberg and Piaget. According to the cognitive development theory of Piaget (1971), youth reach the formal operations stage of cognitive development at the age of 12, wherein they develop the ability for abstract thought (i.e., hypothetico-deductions utilised in consequential thought processes) similar to adults. Similarly, the law postulates that any youth offender over the environmentally expectant age of criminal capacity or abstract reasoning, is capable of adult-reasoning, as posited by Piaget (1971). In addition, legislation presupposes that an offender who can process and integrate the knowledge of right and wrong (i.e., moral reasoning) through consequential thought, can be held criminally responsible. This presupposition is further grounded through Kohlberg's model of moral development, which theorises that an increase in understanding of why a moral choice is right, leads to a greater probability of the individual acting by their understanding of morality (Kohlberg & Candee, 1984). Thus, this theory infers that any young individual capable of abstract thought, who engages in a criminal act, chooses to do so whilst being aware of the possible consequences of their actions.

Morality is a set of customs and values embraced by a community to guide social conduct (Zeki et al., 2004). Therefore, as an individual matures, he/she develops his/her morality by acquiring values and knowledge that direct ethical ways of thinking and behaving (Pillay & Willows, 2015). Moral development is defined as the ways of thinking and behaving when differentiating right from wrong. Generally, younger children make the distinction based on consequences. Further development

progresses until morality underlying one's actions are based on social conventions and the impact on others (Skelton & Badenhorst, 2011).

Therefore, by defining criminal capacity based on consequential thought and morality requires an individual to process and carefully evaluate the relevant weighted information before making a judgement call on his/her actions. In doing so, this indicates that justice and moral decision-making is a 'cold cognitive' process (Steinberg, 2005; Van den Bos, 2007) as it means that the individual's frontal lobe is sufficiently matured to be able to effectively mediate emotional responsiveness. Thus, indicating that moral decision-making is a general competency, where an individual's knowledge and abilities are expressed under ideal circumstances (Woolard, Reppucci & Redding , 1996) and that all reasoning is cognitive, with limited or no influence from the emotive.

### 2.2.3 Criminal responsibility: Adolescent cognition and the influence of impulsivity.

The hallmark of adolescent cognition is the maturation in thinking towards a more abstract, logical and idealistic reasoning (Zeki et al., 2004), thus proving that adolescents have the capability of cold cognitive judgement. However, research also indicates that the effective systems of adolescents tend to override cognitive systems during situations of intensified emotional arousal (Kramers-Olen, 2015; Van den Bos, 2007). Furthermore, the hypothesis of moral dilemmas indicates that by engaging in moral decision-making, cognitive-emotional association complexes are evoked (Kramers-Olen, 2015). This, therefore, conflicts with the idea of cold cognitive processes guiding moral behaviour and moves towards the 'hot cognitive' model, which stipulates that justice judgments are also influenced by affective factors (Van den Bos, 2007).

Furthermore, "adolescence is characterized by a relative dominant focus on rewards and short-term outcomes at the cost of long-term consequences" (Crone, 2014, p. 22). The developmental period from the onset of puberty to mid-adolescence is distinguished by heightened sensation seeking and reward orientation, coupled with difficulties in self-regulation of affect and behaviour (Kramers-Olen, 2015). Impulsivity is defined as this inability of adolescents to inhibit actions without considering potential

consequences (Congdon & Canli, 2008). Impulsivity is thus characterised by a deficit in impulse control, which is theorised to be the root cause of criminal activity (Penney, 2012) as it links to theories of delinquency, antisocial behaviour and predicts early-onset criminal conduct (Bari & Robbins, 2013). Similar to characteristics of impulse control deficits, it is during the adolescent stage of development that individuals have an increased appraisal for risk-taking behaviour (Bari & Robbins, 2013; Kramers-Olen, 2015). Hence, this results in a reduced affinity towards self-regulating behaviour.

Complexities arise when logical reasoning competencies interact with reward-seeking systems, resulting in less carefully reasoned outcomes (Bari & Robbins, 2013; Kramers-Olen, 2015) without much regard for the potentially negative consequences of those outcomes to the individual, or to others (Congdon & Canli, 2008). Although the adolescent brain has developed abstract thinking capabilities, the skill of reasoning concerning real-life problems remains limited to hypothetical dilemmas. Hence the less carefully reasoned outcomes resulting from the weak relationship between adolescents' moral reasoning and their moral behaviour, especially when an individual faces a choice between two equally valid alternatives rather than an ethical dilemma (Steinberg, 2005). Thus, resulting in risk-taking behaviour without the concern of any moral dilemma being present in the behaviour.

An adolescent's ability to understand the probability of risk, but not have the necessary ability to apply that information raises several critical issues concerning the extent and efficiency with which people are able to make sound judgement calls (Zeki et al., 2004). Additionally, research suggests that decisions made by adolescents are influenced by the impact of affect and social contexts (Crone, 2014), which contradicts the standpoint of the law which advocates that an individual's judgement is based on cold cognition.

Considering an adolescent's affinity towards impulsive and risk-taking behaviour, which is further influenced by social and emotional aptitudes during decision-making (Kramers-Olen, 2015), the process of adolescent justice judgement shifts towards the category of hot cognitive processes. By definition, hot cognition is a process that contradicts the ideals of cold cognition and stipulates that

cognitive and affective factors often work together during moral judgement-making, specifically during adolescence (Steinberg, 2005; Van den Bos, 2007).

## 2.3 Neuroscientific Findings and its Links to the Cognitive Component of Criminal Capacity

### 2.3.1 The Structural Brain and its Connectivity

ECF is considered to operate in a hierarchal manner (Bari & Robbins, 2013), which is mediated by the prefrontal cortex (PFC) (Siddiqui, Chatterjee, Kumar, Siddiqui, & Goyal 2008; Zeki et al., 2004). The PFC occupies a third of the entire cerebral cortex and has extensive connections linking it to various subcortical regions and limbic cortices (Siddiqui et al., 2008). Classified as the multimodal association cortex, it uses its rich cortical and subcortical connections to integrate processed information from various sensory modalities to execute ECF (Siddiqui et al., 2008; Zeki et al., 2004).

Due to its extensive connections, the PFC has the ability to "initiate and carry out new and goal-directed patterns of behaviour, inhibitory control of interference, working memory, stimulus detection and sequencing tasks, delayed responding, and active problem solving" (Siddiqui et al., 2008, p. 204). In terms of ECF, the PFC is responsible for planning, response inhibition and adaptive control (Pillay & Willows, 2015; Zeki et al., 2004). It should be noted, however, that the PFC mediates ECF – specifically worded because the PFC in a healthy adult brain controls for impulsivity with the use of inhibitory processes (Kramers-Olen, 2015; Steinberg, 2005).

To mediate ECF, the PFC uses its three major interactive regions: the orbitofrontal cortex (OFC), anterior cingulate cortex (ACC), and dorsolateral prefrontal cortex (DLPFC), which are responsible for the integration of specific cognitive processes (Rosenbloom et al., 2012).

The OFC, classified as the paralimbic cortex, is intimately associated with the amygdala and anterior cingulate. The OFC is involved in behaviour self-regulation through autonomic, response inhibition, reward expectations, and the anticipation and processing of outcomes – not specific to reward production only (Rosenbloom et al., 2012; Siddiqui et al., 2008). Steinberg (2005) posits that the

processes regulated by this region are shown to have a significant role in social and emotional behaviour.

The ACC is a part of the brain's limbic system (Bush, Luu, & Posner, 2000). The region is involved in providing attention to demanding cognitive tasks such as self-initiated movement and conflict resolution (Siddiqui et al., 2008) – the processing that can be determined by the use of Stroop and other neuropsychological tests (Kramers-Olen, 2015). The ACC is also involved in the regulation of emotional processes (Siddiqui et al., 2008). Recent EEG study findings indicate that the ACC is also responsible for error regulation, wherein error-related negativity is influenced by affect and motivation (Bush et al., 2000). Furthermore, the success of error regulation in controlling responses might be correlated with cingulate size (Bush et al., 2000). In summary. The ACC is responsible for various functions ranging from attention for conflict monitoring, anticipation, error detection, working memory and response selection (Bari & Robbins, 2013).

The DLPFC is implicated for playing an important role in legal decision-making (Rosenbloom et al., 2012) as its function is associated with abstract reasoning and cognitive control (Kramers-Olen, 2015). Lesion study results indicate that patients exhibit impairments in major EF processes such as planning, inhibitory control, strategy development, cognitive flexibility, and working memory (Kramers-Olen, 2015; Siddiqui et al., 2008). Thus, indicating that the DLPFC provides the neural circuitry that governs impulse control, judgement, and decision-making. Additionally, Kramers-Olen (2015) posits that the DLPFC exhibits increased activation when responding to difficult personal moral dilemmas. Thus, indicating that the DLPFC also plays a vital role in moral decision-making.

Additionally, the region encompassing the OFC, ACC and frontal polar cortex – which is jointly referred to as the ventromedial prefrontal cortex (VMPFC) (Rosenbloom et al., 2012) – is considered as a "critical neural substrate for the acquisition and maturation of moral competency that goes beyond self-interest to consider the welfare of others" (Taber-Thomas et al., 2014, p. 1254). Lesion studies for the VMPFC indicate that an individual with deficiencies in this region will exhibit poor emotional processing such as failing to experience and recognise social emotions like compassion, shame, and

guilt (Rosenbloom et al., 2012). Furthermore, individuals with deficiencies possess a low threshold for anger and frustration (Rosenbloom et al., 2012), which are known to be biological contributors and risk factors of criminal activity (Bartol & Bartol, 2014).

The function and role of the abovementioned regions indicate that the PFC is responsible for cognitive control and counterfactual thought and its various regions are activated when solving difficult personal moral dilemmas. Furthermore, the developed PFC regulates emotional processes while engaging in moral decision-making behaviour. However, neuroscientific findings provide insight into the development of the PFC, specifically the adult levels of cortical thickness in the DLPFC, to only mature notably later than adolescence (Kramers-Olen, 2015; Steinberg, 2005). Therefore, this implies that the adolescent brain structure differs from a fully developed adult brain.

### 2.3.2 The Adolescent Brain.

Due to recent neurological studies, the adolescent brain is a developing structure that will not achieve complete maturation until early adulthood (Pillay & Willows, 2015). The adolescent brain as a 'brain in transition' has anatomical and chemical differences from that of the adult brain (Kramers-Olen, 2015; Lamb & Sim, 2013; Pillay & Willows, 2015), thus challenging the assumption that the brain has finished developing by puberty and is capable of adult-like reasoning.

With regards to developmental differences between the adult and adolescent brain, four structural changes are most noteworthy. First, a reduction in grey matter in prefrontal regions of the adolescent brain is evidenced (Kramers-Olen, 2015; Zeki et al., 2004), indicative of synaptic pruning, the process through which unused connections within the grey matter are removed or refined (Steinberg, 2005; Zeki et al., 2004). The refinement of these unused synapses correlates with development or maturation in pre-adolescence and early adolescence. The decrease in anatomical synaptic density within this developmental period coincides with changes in basic cognitive abilities and logical reasoning as well as the emergence of new emotional phenomena (Steinberg, 2005; Zeki et al., 2004).

Secondly, a change in the activity of the neurotransmitter dopamine occurs around puberty, usually early adolescence (Kramers-Olen, 2015). There is a substantial increase in dopamine receptors and dopaminergic activity in the PFC and the prefrontal-limbic pathways (Kramers-Olen, 2015; Steinberg, 2012), the region responsible for processing emotions and facilitating the experience of reward and punishment (Steinberg, 2012). Hence, greater vulnerability to risk-taking behaviour is seen as sensation-seeking is high in middle adolescence (14 to 17-year olds), while self-regulation systems are immature (Kramers-Olen, 2015; Steinberg, 2005, 2012).

Thirdly, there is an increase in white matter during adolescence (Steinberg, 2012). This is the result of myelination, the process through which nerve fibres are sheathed in myelin (Steinberg, 2012). Myelin is a fatty substance that insulates the nerve fibres, thus increasing the speed with which signals travel in the brain. Myelinated fibres also function as an index of connectivity within the brain, as they connect regions of grey matter to enable their communication (Kramers-Olen, 2015; Steinberg, 2005, 2012). Unlike the synaptic pruning of the PFC, which is completed by mid-adolescence, the PFC is one of the last cortical regions to undergo full myelination during adolescence (Siddiqui et al., 2008). Furthermore, increased myelination of the PFC is thought to be central for higher-order cognitive functioning equivalent to that utilised in adulthood (Kramers-Olen, 2015; Steinberg, 2005; Zeki et al., 2004). The function of the PFC with its associative regions is therefore dependent not only on the cortical size and structure but also on the white matter pathways (and subcortical structures) (Rosenbloom et al., 2012; Steinberg, 2012).

Lastly, there is improved efficacy of neural connections between the PFC and the limbic system during adolescence (Kramers-Olen, 2015; Steinberg, 2005; Steinberg, 2012). The anatomical change is especially important for emotion regulation, as it improves in the processing of emotionally-charged information with simultaneous development in cognitive control and self-regulation (Kramers-Olen, 2015; Steinberg, 2005, 2012).

**2.4 Summary of Argument: Implications of adolescent brain development on criminal capacity.**

Considering the abovementioned neuroscientific findings, it can be concluded that the PFC is one of the last regions to develop in adolescence, and contrasts with that of the early development of the amygdala – the brain region implicated in contributing to risky behaviours and emotional arousal characteristics in adolescence (Pillay, 2015; Steinberg, 2005). This results in an increased capacity for hyperarousal and emotional responsiveness in adolescents. Furthermore, the underdeveloped structure of the prefrontal region limits an adolescent's access to necessary tools or processes in the PFC to control their impulses or consider alternative outcomes to non-hypothetical situations (Pillay, 2015). Thus, neuroscientific findings create complexities in legislative requirements of criminal capacity as they confirm that adolescents anatomically, and functionally, lack the capability of adult-like competencies in decision-making.

In agreement with Pillay (2015), this research hypothesised that the minimum age in criminal capacity needs to be considered with the possibility of the imbalance between the development of the PFC and limbic cortex. Adding to the subject of the minimal age of capacity, Zeki et al. (2004) posit that developmental neuroscience cannot conclusively dictate a definitive chronological age where the brain reaches complete maturity with absolute certainty. To summarize the above, the abovementioned publications suggest that criminal capacity cannot be considered to be environmentally expectant at a specific chronological age, but can be explored in terms of a maturing frontal lobe and its associated ECF and the individuals developing EI.

# Chapter 3: The Research Framework and its Theoretical Underpinnings

## 3.1. Defining Criminal Capacity in Terms of Hot Cognition

Considering neuroscientific findings in context to cold cognition, the maturation of the PFC is critical to the mediation of ECF (Lamb & Sim, 2013), such as decision-making, problem-solving, planning and response inhibition, and consequently, has a direct bearing on criminal capacity and criminal responsibility (Pillay, 2015; Pillay & Willows, 2015; Zeki et al., 2004). However, Steinberg and Cauffman (1996) posit that in general, "mature judgments are the product of an interaction between cognitive and psychosocial factors" (p. 251), which contradicts the criteria for cold cognition. Therefore, this leads to the implication that justice judgments made by any individual are strongly influenced by affective factors (Van den Bos, 2007) – i.e., all moral decision-making is based on hot cognition.

Due to the neuroscientific evidence empirically proving that adolescent cognition is not inseparable from emotional arousal (Kramers-Olen, 2015), this research will define moral/criminal judgement of adolescents based on the criteria of hot cognition. Wherein, hot cognition will be defined as the use of both EFC – i.e., working memory, planning, abstract thought, error regulation, and response inhibition/impulse control – and emotional intelligence, which is the "capacity to be aware of, control, and express one's emotions, and to handle interpersonal relationships judiciously and empathetically" ("Emotional Intelligence," 2019). Furthermore, since decision-making in adolescents is influenced by emotional arousal and a vulnerability towards reckless behaviour (Steinberg, 2012), it can be hypothesised that hot cognition for criminal capacity in adolescents can be associated with low emotional intelligence due to insufficient error regulation, and the vulnerability for reckless behaviour can be attributed to an imbalance in the ECF of impulse control (i.e., response inhibition).

### 3.2 Theories of Development

To understand the development underlying criminal capacity, the developmental models were considered as the theoretical basis of understanding cognitive and moral development that may influence criminal capacity.

#### 3.2.1 The Works of Piaget and Kohlberg

The initial models of Piaget and Kohlberg were considered as the base theories conceptualising cognitive development in terms of abstract thought (Piaget, 1971) and moral reasoning (Kohlberg, 1971). Although both theories linked well within the legislative reasoning of cold cognition, the abovementioned models limited the view of cognitive and moral development to an environmentally expectant factor to the age of 12 (i.e. the two theories express cognitive and moral development to be fully developed by the age of 12). An additional concern was a point raised by Gilligan and Attanucci (1988), indicating that Kohlberg's interpretations about the individual - based on cultural and gender differences in moral reasoning - were limited by his assumption that moral orientation was governed only by a justice perspective, and as such were not credible for generalisation.

Due to the abovementioned constraints of Piaget and Kohlberg's theories, the theories are considered as important for the base understanding of cognitive and moral development but are not relevant for the focus of this research.

#### 3.2.2 Gilligan's Comparison on the Developmental Differences of the Genders.

Gilligan and Attanucci's (1988) raised the abovementioned concern regarding the credibility of Kohlberg's assumption, as it was only based on research conducted with males. To demonstrate their concern, Gilligan and Attanucci (1988) researched the context of real-life moral dilemmas, with both males and females. The findings of Gilligan and Attanucci's (1988) research indicated that unlike males, females were governed by a care perspective (concerned with the ideal of responsiveness to needs) in their moral judgement. Thus, proving that moral orientation was not only characterised by different

perspectives but was also between the two genders when it came to the emotional reasoning involved in moral judgement. Therefore, not only emphasising the role of emotions in moral reasoning, which relates to hot cognition, but also emphasising the difference between genders on an emotional perspective underlying moral reasoning.

Although Gilligan's theory within the developmental framework introduces an important understanding on the differences of genders on cognitive and moral development, it still leaves gaps in understanding the full extent of the complexities present in a developing brain and its functioning, beyond the precipice of an environmentally expectant model introduced by Piaget and Kohlberg. As such, the theory was considered for its valuable insights on gender differences in choosing the sample, but the theory was not considered as the underpinning theory of this research.

### 3.2.3 Fischer's Dynamic Theory of Development.

Following the abovementioned argument and the framework of this research, Fischer's dynamic skill theory is proposed as the framework to underpin research relating to criminal capacity as it is a more comprehensive theory relating to human development (Fischer, 1980). The reason for showing preference to this theory is that Fischer's theory not only provides an abstract representation of the structures of cognitive skills which emerge during maturation of the brain but also provides a set of rules relating to the transformation taking place between the interacting cognitive structures (Fischer, 1980). These skills, which allow us the capacity to act in a certain way in a certain context, are considered to transform based on emotions, motivation, meaning, and action (Mascolo & Fischer, 2010). Thus, Fischer's theory demonstrates that these cognitive skills develop through levels of increasing complexity within a dynamic system that includes self, others, and the environment. In summary, Fischer's theory not only describes mechanisms of development and a developmental sequence but also considers the impact of contextual and interpersonal factors on learning (Fischer, 1980; Fischer & Bidell, 2006).

Fischer's theory seems to be a more appropriate theory to use because skills are considered both action-based and context-specific (Mascolo & Fischer, 2010), wherein context can be specific to the external, internal and/or interpersonal world. Additionally, Mascolo and Fischer (2010) posits that although skills are constructed in specific contexts, this does not mean they transfer from one context to another. For example, the fact that a participant understands the difference between right and wrong well enough to answer hypothetical scenarios does not imply that he/she will be able to apply these skills in real life. In fact, it does not even imply that he/she will recognise a situation in which it should be applied. Thus, Fischer posits that "any action necessarily involves an integration of cognitive, connotative, and emotional processes" (Mascolo & Fischer, 2010, p.152).

Fischer aptly describes the dynamic development of cognitive skills by discussing it in the context of variability, wherein he analogises skill development and use to a spider's web. Through his web analogy, Fischer and Bidell (2006) explain how a skill can be complex in its development, with growth in change through many pathways at once. His analogy visualises skills developing at different levels at the same time with varying differences across domains, for example, an adolescent can develop abstract thinking prior to error regulation. Fischer further uses the analogy to explain how variability can take place within a specific skill itself, dependent on context (Fischer & Bidell, 2006), thus creating the understanding that an adolescent may demonstrate the skill in one context and fail to do so in another.

### 3.2.4 Summary

Due to its ability to explain the dynamic development of cognitive skills, as well as acknowledging that emotion and social context play a role, Fischer's dynamic skill theory can be considered the most appropriate theory within the developmental framework when working with criminal capacity. The theory is considered a more comprehensive theory on development as it is further conceptualised by the dual-systems model of cognition, which theorises the possibility of the brain functioning according to the 'hot cognitive' process, which is seen in most adolescent risk-taking behaviour (Steinberg, 2012).

The dual-systems/process model suggests that “affective limbic brain regions, such as the ventral striatum, develop at a faster pace than brain regions that are important for control and regulation, such as the prefrontal cortex [and] the dorsal anterior cingulate cortex” (Crone, 2014, p. 27). The framework infers that there are dual mechanisms for cognitive control that are at play to regulate thoughts and actions (Steinberg, 2005).

Therefore, in the context of criminal capacity and impulse control, risk-taking peaks during adolescence because of activation of an early-maturing socioemotional-incentive processing system. Thus, amplifying an adolescents’ affinity for exciting, pleasurable, and novel activities, while the cognitive control system is not yet strong enough to effectively restrain potentially hazardous impulses (Steinberg, 2012). Furthermore, Steinburg (2012) expresses in his research that the dual system model is to date the most accurate account of adolescent risk-taking compared to prior models.

# Chapter 4: Methodology and Research Design

## 4.1 Research Aims and Question(s)

Keeping the abovementioned working definition of hot cognition in consideration, the current research had aimed to assess criminal capacity in terms of the level of EI and ECF present in adolescent boys in Gauteng. The aim was to assess for this 'hot' cognitive criminal capacity between two comparative sample groups of maturing adolescent males within the age ranges of 14-17 from similar demographic backgrounds.

For this research framework, hot cognition was defined as the *ineffective mediation of emotional intelligence by the individual's executive-control functions*. For operationalisation purposes, executive function was measured by looking at working memory, planning, abstract thought, error regulation, and response inhibition/impulse control.

The research wished to answer the question of whether participants caught in contravention to the law are different from participants who have never been caught or convicted, for a crime. To investigate that question, data was analysed with the following questions as guidelines:

1. Are the comparative groups equal on any demographic factors?
2. What executive control function skills are present in boys between the ages of 14 and 17?
3. How do these ECF differ between the comparative sample groups?
4. What level of EI do the convicted individuals display?
5. Does this level of EI differ significantly between the comparative sample groups?

## 4.2 Research Design

This is a descriptive quantitative study. The ontological assumption of the quantitative methodology is based on the same premise as that of realism, which reverts to reality and factual information (Della Porta & Keating, 2008). This positivist paradigm makes use of experiments by finding facts about reality (Babbie, 2013). Quantitative methodology views reality as being objective (Della Porta & Keating, 2008). They believe in cause and effect laws and converges on the truth (Killam, 2013). This

research project was non-experimental in nature meaning the researcher had no direct control over the variables (Babbie, 2013) because the variables being tested cannot be manipulated for experimentation purposes (Babbie, 2013). The current study is defined as a descriptive study as it descriptively explored the subject and became more familiar with the phenomena by gaining new insights without directly controlling the independent variables (Kerlinger & Lee, 2000).

## 4.3 Sample, Sample Criteria, and Sample Strategy

### 4.3.1 Sample.

The total sample of collected data (*N = 172*) comprised of adolescent males from the interest group (i.e. youth caught for being in contravention with the law who are placed in Youth Secure Care Centres (YSCC) for the duration of their trial or conviction period), and the contrast group (i.e. participants who had not been convicted of, nor been caught in suspicion of, a crime). Participants from two YSCC's and two schools (within the *Johannesburg Central's Education District)* were approached for data collection. For details of the process of choosing the two particular schools, please read the sampling strategy section (Section 4.3.3.) below.

However, based on the sampling criteria (mentioned in section 4.3.2 below), as well as some non-compliance in participation (details provided in the *Table 4.1*. below), 42 participants (54 %) were viable for data analysis from the YSCC sample and 65 participants (68 %) were viable from the school sample. As such, the total number 107 (62 %) adolescent males, from the 172 participants data was collected from were considered compliant with the ideals of psychometric test administration as per the published tests manuals.

#### *4.3.1.1 Demographics of the Original Sample.*

The total sample comprised of 77 YSCC male participants (*M = 15.86; SD = 0.98)*, and 95 school male participants (*M = 14.96; SD = 1.56*). Validity and accuracy of reported demographic information relating to age and date of birth were cross-checked (e.g. the reported age was cross-checked against

their date of birth or ID number within Excel calculations). *Table 4.1.* below details the participant age particulars of the two groups.

*Table 4. 1: Frequency of Age Variation in Original Sample*

| Characteristic | Interest Group (YSCC) | | Contrast Group (School) | | |
|---|---|---|---|---|---|
| | Frequency | Percentage | Frequency | Percentage | N |
| **AGE** | | | | | |
| 13 | 0 | 0.0 | 17 | 17.9 | 17 |
| 14 | 6 | 7.8 | 23 | 24.2 | 29 |
| 15 | 21 | 27.3 | 16 | 16.8 | 37 |
| 16 | 23 | 29.9 | 18 | 18.9 | 44 |
| 17 | 21 | 27.3 | 21 | 22.1 | 42 |
| 18 | 1 | 1.3 | 0 | 0.0 | 1 |
| Unknown | 5 | 6.5 | 0 | 0.0 | 2 |
| **Group Total** | **77** | **100.0** | **95** | **100.0** | **172** |

### 4.3.2 Sampling Criteria.

#### *4.3.2.1 General Sampling Criteria.*

The general sampling criteria consisted of certain inclusion and exclusion criteria. The inclusion criteria required all participants to be adolescent males between the ages of 14-17 years who have/had studied in a public school. The exclusion criteria specified that participants had not (1) suffered from previous major head injuries, (2) been diagnosed with a specific barrier to learning, (3) and/or takes any chronic medication before or at the time of the research study, or (4) attended a private school or a school for special needs (due to learning problems). Some participants met two or more exclusion criteria simultaneously, as such the number of participants meeting exclusion criteria were not added to provide a group total as it would lead to an incorrect number of participants meeting exclusion criteria. For particulars of the exclusion criteria numbers between the two sample groups, please see Table 4.2. below.

*Table 4. 2: Description of Participant Numbers Meeting Exclusion Criteria*

| Characteristic | Interest Group (YSCC) | | Contrast Group (School) | |
|---|---|---|---|---|
| | Frequency | Percentage | Frequency | Percentage |
| **EXCLUSION CRITERIA** | | | | |
| Missing Information for exclusion criteria | 5 | 6.5 | 4 | 4.2 |
| Incorrect/Unknown Age Group | 3 | 3.9 | 17 | 17.9 |
| Use of Chronic Medication | 3 | 3.9 | 2 | 2.1 |
| Major Head Injury | 10 | 12.5 | 3 | 3.2 |
| Learning Disability | 9 | 11.7 | 1 | 1.1 |
| Been to court in suspicion of a crime | **N/A** | **N/A** | 5 | 5.3 |
| Attended Special School | 5 | 6.5 | 0 | 0.0 |
| Attended Private School | 1 | 1.3 | 0 | 0.0 |
| Did not do Computer-based Test Battery | 7 | 9.1 | 3 | 3.2 |

#### *4.3.2.2 Sampling Criteria Specific for School Sample Selection*

An exclusion criterion specific to the school samples was the requirement that none of the participants had previously been caught in suspicion of a crime. An additional sampling criterion was that the two schools chosen for data collection had to be selected from the YSCC participants' educational background.

### 4.3.2 Rationale for Sample and Sampling Criteria

Two samples of boys between the ages of 14 and 17 were decided on since the current legislation in RSA sets the maximum age for the criminal capacity to be at 14 years (Child Justice Act, 2008). Additionally, it was noted above that the UN encourages minimum capacity to be set between 14-17. A further rationale is the link of the abovementioned studies, which indicate that on a physiological level, reasoning skills are at a mid-adolescent functioning capacity. As such, the functioning can have a possible impact on criminal capacity due to the higher-order cognitive functions still undergoing maturation in the developing brain structures (Crone, 2014; Lamb & Sim, 2013; Skelton & Badenhorst, 2011).

Male participants were focussed on since sociologically, there are some Youth Secure Care Centres (YSCC) that accommodate only male youth offenders (see Appendix A). Adding to the above, as discussed above in *Chapter 3.2.2*, there is a known physiological difference in neurological development between males and females (for more information on this please read: Bartol & Bartol, 2014; Bezuidenhout, 2013; Gilligan & Attanucci, 1988). As such, a gender difference can contribute as a variable/developmental risk factor impacting capacity. Therefore, to clearly confine the variables that were tested, and to prevent the study from becoming too broad, only one gender was chosen to form part of the research participants.

The exclusion criteria were specified to reduce the extraneous variables that are known to impact on psychometric assessment. For example, major head injuries can be linked to possible neurological impairment that can affect psychometric results (Adesegha, 2015; Crone, 2014; Maoz & Yafe, 2014). Use of chronic medication could be an indicator of chronic diseases such as HIV, which affects the blood-brain barrier (McRea, 2016) and result in possible neurological dysfunction (Bartol & Bartol, 2014; Bezuidenhout, 2013, McRea, 2016). Diagnosis of learning disorders was considered to account for individual experiences of difficulty when partaking in the neurocognitive or EI tests, which could skew the data. Information regarding failed or repeated grades was also asked for a descriptive comparison between groups on possible barriers or difficulties experienced in learning within the groups.

The rationale for choosing two schools from within the YSCC participants educational background was an attempt to homogenise the comparative samples based on educational background, to assist with the aim of the research (i.e. to compare the two sample groups).

### 4.3.3 Sampling Strategy

The research used non-probability purposive sampling strategy to invite participants. This was due to the inclusion criteria restricting the sample to a specific gender as well as a specific age-group. A purposive sampling strategy was also adopted to fit the research design, which required the schools, from which participants were invited, to be matched to YSCC participants based on YSCC participant's

educational history (i.e. schools are compared based on YSCC participants' similarity in the educational background). In the case of this research, both schools selected matched within the *Johannesburg Central* Education District of Gauteng.

To achieve homogeneity, the educational background from the 42 *viable* YSCC participants was investigated and the schools were chosen by the following two methods, (1) a school was selected as it was a frequently occurring school name within the sample data (a total of 3 YSCC participants were reported to have attended this school prior to their alleged crime and it was the only school name repeated in the data set), and (2) the second school was selected by searching a school name from the YSCC data, which was located in the most frequently occurring education district (i.e. *Johannesburg Central*) and school quintile (*Quintile 4*). For particulars of the educational background of the 42 viable YSCC participants, please refer to *Table 4.3.* below.

*Table 4. 3: Descriptive results indicating the educational background frequencies from the viable YSCC sample*

| Characteristic | Frequency | Percentage |
|---|---|---|
| **Quintile of School** | | |
| Quintile 1 | 8 | 19 |
| Quintile 2 | 3 | 7.1 |
| Quintile 3 | 7 | 16.7 |
| Quintile 4 | 10 | 23.8 |
| Quintile 5 | 7 | 16.7 |
| Missing Information | 7 | 16.7 |
| Group Total | 42 | 100.0 |
| **Education District** | | |
| Gauteng East | 2 | 4.8 |
| Gauteng West | 5 | 11.9 |
| Johannesburg North | 4 | 9.5 |
| Johannesburg South | 1 | 2.4 |
| Johannesburg Central | 10 | 23.8 |
| Johannesburg West | 1 | 2.4 |
| Johannesburg East | 2 | 4.8 |
| Sedibeng East | 1 | 2.4 |
| Sedibeng West | 1 | 2.4 |

| | | |
|---|---|---|
| Tshwane North | 3 | 7.1 |
| Tshwane South | 1 | 2.4 |
| Tshwane West | 4 | 9.5 |
| Missing Information | 7 | 16.7 |
| Group Total | 42 | 100.0 |
| **School Quintile Distribution in Johannesburg Central** | | |
| Quintile 2 | 1 | 10.0 |
| Quintile 3 | 2 | 20.0 |
| Quintile 4 | 5 | 50.0 |
| Quintile 5 | 2 | 20.0 |
| Group Total | 10 | 100.0 |

## 4.4 Demographic Characteristics of Participants

### 4.4.1 Demographics of the viable data set.

The sampling criteria (discussed in Section 4.3.2) was applied to exclude selected cases which could be influenced by the abovementioned extenuating variables. After excluding the relevant cases 42 YSCC participants (*M = 15.86; SD = 0.87)* and 64 school participants (*M = 15.45; SD = 1.18)* were viable for the comparative analysis of the data obtained from the EI and neurocognitive tests. For more particulars on the age distribution and home language of the participants that met all inclusion criteria, please see *Table 4.4.* below.

*Table 4. 4: Demographic particulars of the participants viable for comparative analysis*

| Characteristic | Interest Group (YSCC) | | Contrast Group (School) | | |
|---|---|---|---|---|---|
| | Frequency | Percentage | Frequency | Percentage | N |
| **AGE** | | | | | |
| 14 | 2 | 4.8 | 19 | 29.7 | 21 |
| 15 | 13 | 31.0 | 14 | 21.9 | 27 |
| 16 | 16 | 38.1 | 14 | 21.9 | 30 |
| 17 | 11 | 26.2 | 17 | 36.6 | 29 |
| Group Total | 42 | 100.0 | 64 | 100.0 | 106 |
| **HOME LANGUAGE** | | | | | |
| English | 4 | 9.5 | 13 | 20.3 | 17 |
| Afrikaans | 4 | 9.5 | 9 | 14.1 | 13 |

| | | | | | |
|---|---|---|---|---|---|
| Setswana | 8 | 19.0 | 0 | 0.0 | 8 |
| Sesotho | 3 | 7.1 | 7 | 10.9 | 10 |
| Isizulu | 17 | 40.5 | 20 | 31.3 | 37 |
| Sepedi | 2 | 4.8 | 1 | 1.6 | 3 |
| Xhosa | 0 | 0.0 | 2 | 3.1 | 2 |
| Other | 2 | 4.8 | 10 | 15.6 | 12 |
| Missing | 2 | 4.8 | 2 | 3.1 | 4 |
| Information | | | | | |
| Group Total | 42 | 100.0 | 64 | 100.0 | 106 |

Additionally, to get a clear visual of the YSCC demographics, Table 4.5. below provides particulars of the conviction status and length of stay at their particular YSCC from the viable participant sample that met all the inclusion criteria. The YSCC sample demographic comes from mostly youth who are divergent (71.4%) and have been in the programme for less than 6 months (66.7%).

*Table 4. 5: Conviction status and duration of stay at YSCC of the YSCC participants.*

| Characteristic | Frequency | Percentage |
|---|---|---|
| **CONVICTION STATUS** | | |
| Divergent | 30 | 71.4 |
| Trial | 9 | 21.4 |
| Unsure of Status | 1 | 2.4 |
| Missing Information | 2 | 4.8 |
| Group Total | 42 | 100.0 |
| **LENGTH IN THE DIVERGENT PROGRAMME** | | |
| Not in the divergent programme | 9 | 21.4 |
| < 6 months | 28 | 66.7 |
| 6 – 12 months | 3 | 7.1 |
| 12 – 18 months | 1 | 2.4 |
| > 18 months | 0 | 0.0 |
| Missing Information | 1 | 2.4 |
| Group Total | 42 | 100.00 |

## 4.5 Procedures

All necessary ethical and statutory permissions were obtained and will be discussed in detail in the ethical considerations section (in chapter 4.8) below. The research information session differed for both schools and YSCC due to logistical reasons. The researcher first started data collection by approaching two of the three YSCC's in Gauteng, thereafter, choosing two schools which match with the YSCC sample's educational background, based on the frequency of youth convicts from a specified area or frequency of youth convicts from a specified school.

### 4.5.1 Information and Consent Procedure Followed at the YSCC's.

At the YSCC, all boys within the age ranges of 14-17 were gathered to introduce the aims of the research and provide information on the process of participation. During the information session, the boys were verbally informed of the research aims, and the information sheet (Appendix I) was read and explained to the participants while the case managers were present (this is following their ethical policy). The young participants were informed verbally that they may reach out to their case managers and counsellors for any counselling or debriefing they may wish for, post their participation (as per their ethical policy and guidelines). Names of the interested participants were noted, along with their date of birth, to set up a register which was used for various purposes, namely; (1) to keep track of the number interested participants, (2) to identify individuals who can be called for the data collection sessions, (3) assigning of participant ID numbers, and (4) to keep track of completion of tasks or if a participant decided to leave the study.

On the information session day, the premises were checked for working computers available or if the researcher needs to bring personal devices. Computers were only available for use at one of the two YSCC's. Where the computer facility was available, the programme was uploaded onto the computers with the assistance of the IT technician present. The YSCC where computer facilities were lacking, laptops belonging to Wits University and the researcher were taken for data collection purposes.

On the data collection days, the participants chosen for the day's session were briefed on the research purpose and process again and the signed consent forms were collected. Initially, approximately 3 to 6 participants were chosen to be tested simultaneously for each session (approximately an hour-long). The researcher conducted between 2 to 3 sessions per day, depending on the availability of participants and their class schedule of the day.

### 4.5.2 Information and Consent Procedure Followed at the Schools.

Once two schools had been selected, matching the educational background of the YSCC sample, the schools were approached for the appropriate permissions required for data collection (see Appendix T) The information session was hosted one week prior to the commencement of data collection to allow potential participants to get parental consent. As per the agreement with the schools, students were approached in their classes, ranging from grades 8 – 11, requesting an audience with the boys in a designated meeting place. An information session was held within the designated meeting place, following the abovementioned protocol of introducing the research and reading the participant information sheet. Participants were provided with an opportunity to ask questions regarding the research and they were informed that to participate, their parents needed to sign a consent form to allow them to participate. All interested young males were requested to sign a register with their name, class and date of birth and to collect the parent/guardian information sheet (Appendix J) and parent/guardian consent form (Appendix L). Two alternative travel days were set out to allow for any further questions of students or their parents, as well as to serve reminders for the parent/guardian consent forms to be signed and collected by the researcher.

Similar to the procedure followed at the YSCC's, computer facilities were checked on the information session day, only one of the two schools had working facilities, and the programme was loaded on the available computers and the Wits University laptops were used at the other school.

During the data collection sessions, participants were assigned to each one-hour session according to grade and class. Based on the experience at the YSCC's, only 3-4 participants were called at a time for

a data collection session. The researcher conducted between 2 to 3 sessions per day, depending on the availability of participants and their class schedule of the day.

### 4.5.3 Procedure of Participant Information Sheet Administration

After collecting the signed assent forms (Appendix K), and where applicable the parental consent forms (Appendix L), the participants were assigned a unique participant ID, to allow for the confidentiality of their answers and test results. Once participant ID's were assigned, the participant information questionnaires specific to the youth convicts (Appendix C) or school participants (Appendix B) were handed out and completed with the assistance of the researcher. The researcher assisted in the administration by reading the questions aloud to assist those who struggle with reading (for more information please read section 4.6.1.2 for details of the questionnaire's administration). The participants could choose whether they wanted to respond to the question on the paper in front of them or not, aligned with the ethical rights of participants of research. All pens and papers were collected prior to the commencement of the computer-based test.

### 4.5.4 Computer-based Test Battery Administration

After the completion of the participant information questionnaire, the computer-based test battery was administered in the following format: (1) the Schutte Self-report Emotional Intelligence Test (SSEIT), (2) the Tower of London (TOL), (3) The Wisconsin Card Sorting Test (WCST) and ended with the (4) Stroop Colour-Word Test (Stroop). Two of the four computer-based tests selected (i.e. TOL and Stroop) had a trial run built within the Inquisit programme. The trial runs were used by the researcher to familiarize all the participants with the computer or laptop's mouse and keyboard system and to specifically guide participants who were computer illiterate or faced technical difficulties. However, for the two tests that did not have a trial (i.e. the WCST and SSEIT the researcher guided participants who requested assistance by providing a brief explanation of how to use the mouse to select their response.

### 4.5.5 Storing of Test Results

Once the test battery was completed, all results were automatically saved in millisecond format, with the assigned person ID as the file name reference. All results or each participant were stored on a password-protected laptop belonging to the researcher and removed from the other computers and laptops. Once all potential participants had been tested, the millisecond software was deleted from all devices not belonging to the researcher and Wits University.

## 4.6 Measures

The research measures consisted of a self-report participant information questionnaire (i.e. demographic questionnaire), and a computer-based neurocognitive test battery comprising of three neurocognitive measures and an emotional intelligence scale.

The participant information questionnaire was designed to collect demographic data relating to the inclusion and exclusion criteria of the study (Appendices B and C). The questionnaire will also be instrumental in collecting data on some of the known risk-factor variables that can influence criminal capacity (for more on the risk factors read Bartol & Bartol, 2014; Bezuidenhout, 2013).

The test battery was downloaded from the Millisecond Test Library (online) and was run using the Millisecond Inquisit Lab 5 programme (Inquisit 5, 2016). The Millisecond Inquisit Lab was chosen as it offers a built-in 30-day free trial per device. During this trial, the software is fully functional and allows for testing and storing data with ease on the installed programme. However, when the evaluation period expires, Inquisit will continue to run scripts (i.e. the scoring sheets), but data can no longer be recorded.

The battery consisted of three neurocognitive measures, namely, the *Wisconsin Card Sorting Test, The Stroop Colour Word Test, Tower of London;* as well as the *Schutte Self-Report Emotional Intelligence Test* to test for emotional intelligence. The neurocognitive test battery was selected to test for cognitive

control functions such as planning, error regulation, working memory, relational reasoning and inhibition/impulse control, whereas the EI test was selected to test for the level of insight. Each test came with its instructions on how to complete the test using either the mouse or the keyboard.

### 4.6.1 Participant Information Questionnaire - Demographic Data Collection.

#### *4.6.1.1 Nature of the Questionnaire*

Questions regarding age and gender were asked to ensure participant meets inclusion criteria. Questions regarding chronic medication, previous head injuries and diagnosed learning disability were in line with determining if any participants meet the exclusion criteria mentioned in this chapter in section 4.3.2. Questions regarding school, neighbourhood, living conditions, familial history of incarceration and substance use (optional question) were asked to compare group demographics for any form of equivalent factors between them, as well as to assess the prevalence of possible influencers of motivation. Adding to the abovementioned rationale, information gained on neighbourhood and schools can be used to match equivalence of the sample groups relative to the prevalence of criminality within their society for future studies but was not done for the current study's findings. Lastly, two similar, but separate questionnaires were created so that the *Youth Centre Participant Questionnaire* (Appendix C) could ask specified questions regarding their conviction status and the time spent at the YSCC, and the *School Participant Questionnaire* (Appendix B) can ask specifics of the participant ever being caught previously in suspicion of a crime.

#### *4.6.1.2 Administration of the Test*

The questionnaire used close-ended questions which were answered by hand by ticking the appropriate categorical boxes (see appendices B and C). During the administration of the questionnaires, the researcher would read the questionnaire with the participants during their session to allow for questions and assist those who struggle with reading.

The researcher noted that participants struggled to comprehend questions asking about chronic medication, head injury and learning disability. Due to the necessity of the information required, the

explanations listed below were adapted from online sources and vocalised as explanations during the administration of the test in the following format:

For the question, "*Do you need to take any chronic medication?*", The following response was adapted from a peer-reviewed medical information website titled MedicineNet (Shiel, 2018).

- "*This is medication you need to take on almost a daily basis for a period of 3-months or more for health conditions such as Diabetes, HIV, TB, Depression, etc*."

For the question "*Have you been diagnosed with a learning disability*?", the basic information provided on the NIH website (*How are learning disabilities diagnosed?*, 2018) was used as a guideline to adapt the explanation into the following phrases.

- *Please Tick **Yes** if a psychologist or a school counsellor has tested you and officially informed you and your parents that you have a problem with learning.*
- *Please Tick **No** if you **think** you have a problem with learning but have not been tested by a professional.*
- *Please Tick **Unsure** if you think you have been tested by a psychologist or teacher, but cannot remember.*

For the question, "Have you ever had a head injury?" the information available on the peer-reviewed medical information website titled *Healthline* (Reed-Guy, 2018), was adapted into the following vocalised explanation.

- *Please Tick **No** if you have never bumped your head.*
- *Please Tick **Mild** if you have ever bumped your head playing soccer, for example, or in a small accident and had any of the following symptoms for **one day or more** (1)Dizziness, (2) Confusion, (3) Feeling like you need to vomit or (4) Ringing in ears*
- *Please Tick **Major** if you have ever hurt your head in an accident and required a major operation on your skull or brain.*

- *Please Tick **Major** if you have ever hurt your head in an accident or event and experienced the following (1) Fainting, (2) Vomiting, (3) Struggling to focus eyes, (4) Mood swings, or (5) A headache that won't go away.*
- *Please Tick **Don't Know** if you cannot remember if you ever hit your head, or if you did hit your head but do not remember if you experienced any of the abovementioned symptoms.*

### 4.6.2 Wisconsin Card Sorting Test (WCST) – Computer-based Neurocognitive Test.

The Wisconsin Card Sorting Test (WCST) was selected as it is a neuropsychological test that is reported to be frequently used to measure cognitive processes such as attention, perseverance, working memory, cognitive fluidity and concept formation (Coulacoglou & Saklofske, 2017; Singh, Aich, & Bhattarai, 2017). The test was considered appropriate for use as it is known to be used in clinical fields to measure perseverative behaviours which reflect individual's insistence on following wrong behaviour (Coulacoglou & Saklofske, 2017), which is an important underlying assumption for criminal capacity.

#### *4.6.2.1 Information of the Test*

The Millisecond Software *Wisconsin Card Sorting Test (WCST)* is a computerised version of the test developed by Grant and Berg (1948). The original card sorting test was developed as a neurocognitive index for executive control functions (Kovács, 2015). WCST specifically measures abstract reasoning, concept formation (working memory), and response strategies (inhibition) to changing contextual contingencies (Kovács, 2015; Nyhus & Barceló, 2009).

#### *4.6.2.2 Nature and Administration*

The test consists of four key cards and 128 response cards, each with geometric figures that vary per colour, form, or number. The task requires participants to find the correct sorting principle through trial and error and computer-based feedback. Once the participant selects the correct rule, they must maintain their hypothesis (or set) in working memory through changing stimulus conditions, while ignoring the other irrelevant stimulus dimensions. After ten consecutive correct matches, the sorting principle changes without warning, requiring a flexible shift in set (Nyhus & Barceló, 2009). See Appendix D,

Figures 1 and 2 for the instructions provided to the participants, and Figure (3) to see an example of the test layout. Therefore, to perform well requires an individual to plan, execute their plans, monitor self-correction in light of corrective feedback, changing of the hypothesis (plan), and flexible thinking (Kovács, 2015).

This specific computer-based test has three sorting rules, each containing four categories. The first sorting rule is colour, containing the colours of red, green, blue and yellow. The second sorting rule is shape, containing stars, dots, triangles and crosses. The last sorting rule is number (see appendix D Figures 4 - 7 for examples). For more information on the test rules please read Grant and Berg (1948).

The two main variables of the WCST are Number of Categories achieved (range: 0-6) and Number of Perseverative Errors (Kovács, 2015). Furthermore, WCST is not timed, so sorting continues until all cards are sorted or a maximum of six correct sorting criteria have been reached (i.e. have completed two sequences of colour, form and number) (Nyhus & Barceló, 2009).

#### *4.6.2.3 Data Capturing Format and Variables*

Please refer to the two tables in Appendix E which summarize the data provided by the Millisecond Software Test Library. The tables provide an exact indication of which variables are captured by the programme as the participants complete the test. The tables also indicate what information the variables provide about the data captured. There are two tables present as the programme captures data in two sets, one set is the raw data capturing all responses, and the other data set is a summarised version of the raw data.

### 4.6.3 Tower of London Test – Computer-based Neurocognitive Test.

The TOL is a frequently used neurocognitive planning task used for assessing and measuring planning skills used in real-life contexts (Luciana et al., 2009). Additionally, the TOL is also known to be used in developmental studies when testing for planning and also shows correlations to the cognitive functions of working memory and inhibitory control (Luciana et al., 2009; Welsh et al., 1999).

#### *4.6.3.1 Information of the Test*

The Millisecond Software *Tower of London* (TOL) test was adapted to a computerised version initially developed by Shallice (1982). The test was developed to assess disturbances in planning, one of the processes of executive function (Lezak, 1995). The task requires the participant to rearrange three coloured disks from their initial position on three upright pegs – of varying lengths - to a new set of predetermined positions on one or more of the pegs (Lezak, 1995, p. 657). The original test consists of 16 test items with gradually increasing level of complexity, however, the computerized version only consists of 12 test items (see Figures in appendix H for test examples). To complete the task successfully, the participant is required to rearrange the disks within the restricted range of the minimum number of possible – which gradually increase with item complexity from 2 moves to 5. Errors will result in a repetition of the item until it has been completed (Kovác, 2013; Kovác, 2015).

The successful completion of the task requires: initiating and sustaining attention, planning and strategic thinking, evaluating feedback and the capacity to react flexibly to errors, (Kovác, 2013). The task also requires good visual perception and good attentional control to maintain a focus/goal, despite the interference of other irrelevant information and/or response inhibition due to self-monitoring and self-correction techniques (Kovács, 2015).

#### *4.6.3.2 Reliability*

As for its psychometric properties, reasonable test-retest reliability has been reported of the test score, varying from .58 to .66, and a fair convergent validity ranging from .38 to .43 (Lezak, 1995, p. 199). Furthermore, Lezak (1995, p. 119) justifies the low test-retest reliability by indicating that a measure of executive function that relies on task novelty cannot establish the reliability due to the consideration that not all groups of patients/participants are stable over time.

#### *4.6.3.3 Nature and Administration*

The computerised version of the TOL test starts with task instructions (see appendix F, Figure 8), adapted from a publication by Anderson, Anderson, & Lajoie, (1996). Thereafter, it is followed by one

trial run consisting of 2 moves (see examples in appendix F). As mentioned above, the task consists of 12 problems (see Appendix G for examples), of which the procedures were adapted from a publication by Krikorian, Bartok, and Gay (1994). The participants will be asked to move the disks once at a time used their mouse to pick and drop the discs on the pillars of their choice. Due to the study scope being limited to the computerised test, the abovementioned publications will not be discussed.

#### *4.6.3.4 Data Capturing Format and Variables*

See Tables 4.6.3.4.1 – 4.6.3.4.2 in Appendix H pertaining to details of specific data variables captured by the Inquisit Lab computerised test as the participants complete the test. The tables are provided by the Millisecond Inquisit 5 software in the test manual than can be downloaded online (Inquisit 5 Tower of London, 2016). The tables also indicate what information the variables provide about the data captured. There are two tables present as the programme captures data in two sets, one set is the raw data capturing all responses (Table 4.6.3.4.1.), and the other data set is a summarised version of the raw data (Table 4.6.3.4.2).

### 4.6.4 Stroop Word-Colour Task – Computer-based Neurocognitive Test.

Khng and Lee (2014) report that recent inhibitory control models conceptualize the performance of the Stroop Word-Colour task as a result of both goal maintenance (i.e. attentional inhibition) and interference (i.e. response inhibition). However, Khng and Lee (2014) also caution that results for the task performance are dependent on variations in both personal and situational factors (e.g., cognitive control function use, age & motivation for control). Adding to abovementioned areas of the testing present, the Stroop was selected as it is also reported as the only ECF measure which holds some evidence of validity when testing with adolescents (Nyongesa et al., 2019).

#### *4.6.4.1 Information of the Test*

*Stroop Word-Colour Task* is a measure of executive function originally developed in 1935 by Stroop. The main purpose of the measure is to assess an individual's ability to shift cognitive set, wherein it is believed to provide the measure of selective attention and cognitive flexibility (Homack & Riccio,

2004), cognitive inhibition, inhibition of stimulus-bound/ dominant responses in favour of an unusual response, and the ability to deal with interference (Homack & Riccio, 2004; Scarpina & Tagini, 2017).

#### *4.6.4.2 Nature and Administration*

The Millisecond Software task is a computerised version of the original test developed by Stroop (1935), using a keyboard response system. The computerised task consists of giving participants colour words written in colour and then asking the participants to indicate the colour of the word (not it's meaning) by the keypress as fast as they can without making too many errors (see appendix G, Figure 25 for instructions).

The task consists of three components. The first two components require the participant to (i) name a series of colour words that are written in their original colour (i.e. Word task), which is also known as a congruent trial (see appendix I, Figure 26 for example). Then (ii) name the colour of a bar (i.e. Colour task), which is referred to as the control in the computerised test results (see appendix G, Figure 27 for example). The results of these first two components are used as a baseline to test for basic reading rate and ability to name colours. The initial components are used to assess if the individual suffers from any speech motor function or learning disabilities (Homack & Riccio, 2004; Scarpina & Tagini, 2017). In the third component, the individual is shown the names of colours printed (the words) in conflicting ink colours (e.g., the word “blue” in red ink) and is asked to name the colour of the ink rather than the word (i.e. Colour-Word task as described by Homack & Riccio, 2004; Scarpina & Tagini, 2017). This third component is reported as an incongruent trial in the result (see appendix I, Figure 28 for example).

#### *4.6.4.3 Reliability*

The reported temporal reliability of the test is good ($\alpha > 0.80$), as reported in a few studies (Homack & Riccio, 2004; Scarpina & Tagini, 2017). However, these abovementioned studies infer the same caution as noted by Khng and Lee (2014, reporting that the education level attained and level of intelligence are known predictors of performance, thus may confound results.

#### *4.6.4.4 Data Scoring Format and Variables*

Please refer to the two tables in Appendix J for particulars of the exact data variables captured by the programme as the participants complete the Stroop task. The tables summarise the information provided by the Millisecond Inquisit 5 software in the test manual than can be downloaded online (https://www.millisecond.com/download/library/stroop). The tables in Appendix J also summarise the relational information of the data variable to the ECF being tested, as well as the exact responses which cause data to be captured as a certain variable.

### 4.6.5 Schutte Self-Report Emotional Intelligence Test – Computer-based EI Test.

#### *4.6.5.1 Information of the Test*

*Schutte Self-Report Emotional Intelligence Test* is a method of measuring general Emotional Intelligence (EI) developed by Schutte et al., (1998). The test developed was originally structured from the EI model developed by Salovey and Mayer (1990). It uses four sub-scales: emotion in the self and others, expression of emotion, regulation of emotion in the self and others, and utilization of emotion in solving problems (Schutte, Malouff & Bhullar, 2009). The Millisecond Software computerised version implements the original test developed in 1998 by Schutte et al.

#### *4.6.5.2 Nature, Administration and Scoring*

The scale consists of a 33-item self-report inventory focusing on typical emotional intelligence (see Appendix K for all items in the test). Participant responses are captured on a five-point scale ranging from "1=strongly disagree" to "5= strongly agree". Participants require an average of five minutes to complete the scale. Refer to Appendix G for the measure and instructions (Schutte et al., 1998). To calculate total scale scores, items 5, 28 and 33, need to be reverse coded; and then all items summed up to get the total score. However, the computerised version automatically reverse scores the abovementioned items when calculating the results (Inquisit 5 SSEIT, 2018). Scores can range from 33 to 165, with higher scores indicating more characteristic emotional intelligence (Schutte et al., 2009).

#### *4.6.5.3 Reliability*

Schutte et al., (2009) indicate a reliability rating of 0.90 for their emotional intelligence scale. The subscale reliabilities are reported as: Perception of Emotion, .76, .80; Managing Own Emotions, .63, .78; Managing Others' Emotions, .66, .66 and Utilisation of Emotion, .55. In the present study, EI is reported as a composite score as in neither of the abovementioned referenced studies (i.e. Schutte et al., 1998; Schutte et al., 2009) do the authors' state which items compose each of the respective subscales. The authors (i.e. Schutte et al., 2009) do report a two-week test-retest reliability for total scale scores to be .78. According to the report, all the reliability ratings seem to be strong enough for research purposes ($\alpha > 0.6$), except for the subscale of "Utilisation of Emotion", which is just under the preferred reliability rating of $\alpha > 0.6$.

## 4.7 Data Analysis Method

All statistical analysis of collected data was run using SPSS, Version 25.0 (IBM Corp, 2017). All data responses were cleaned and coded onto SPSS and descriptive statistics were run to gain insight on the number of responses between sample groups and per age-groups. Thereafter data was further cleaned and all non-viable participants who did not meet inclusion criteria were removed before further data analysis.

### 4.7.1 Demographic Questionnaire Data Analysis

Descriptive statistics (i.e. frequencies and percentages) were analysed and summarised into tables comparing the two sample groups based on all risk variables data were collected on through the demographic questionnaire responses (see Appendices B and C for details of questions asked). Sample groups were compared using the descriptive statistics to assess similarities and difference between the two samples (as summarized by the tables in Chapter 5). Any demographic factors which confirmed a difference in descriptive frequencies between groups were further analysed using the Chi-Square test of significance to test for significant differences between groups. Significant differences were reported

on and discussed with the effect size taken into consideration. For details on why the Chi-Square test was selected and how the effect size was calculated, please refer to Chapter 5, Section 5.2.

### 4.7.2 Emotional Intelligence Scale Data Analysis

All statistical tests for the individual items were run using the reverse scores for items 5, 28 and 33. To conduct meaningful data analysis, the reliability of the EI scale for RSA male adolescent population was tested first. Thereafter, parametric assumptions were tested for and discussed in detail (see Section 5.3.3 in Chapter 5). Descriptive statistics were reported in terms of mean scores between groups, as well as within-group scores per age group to assess any descriptive differences between groups on scores. Any observed descriptive differences between groups on each composite item were further tested for significance of the difference between groups using *independent samples t-tests*. Of the items which confirmed significant differences between the two sample groups, further descriptive analysis was used to graphically illustrate the difference in means scores per age-group between the two samples. The further descriptive illustration was conducted to view the scoring trajectory between the two groups as well as to confirm any observable difference in age-groups between the two samples to add depth to the analysis. Lastly, a power analysis was run to confirm the statistical strength and validity of the abovementioned analyses.

### 4.7.3 Executive Control Function Tests

Data analysis for the ECF tests was conducted in two phases. The first phase analysed each ECF test individually, cleaning the data responses of each test separately and according to the extreme outliers and exclusion variables for each test (please read particulars in Chapter 5). Thereafter, the scores for each test variable were descriptively discussed and graphically illustrated to assist in the exploration of the differences between groups for further insights.

The second phase of data analysis incorporates the use of factor analysis. Factor analysis is incorporated to assist in exploring common underlying dimensions within the data (Field, 2013) (i.e. we want to explore common underlying cognitive skills present within the two samples). The FA test chosen for data analysis was a Principle Component Analysis (PCA) as it identifies the underlying component

present within the available data set (Field, 2013). The reason for using a PCA is because the chosen ECF tests assess higher cognitive constructs which consist of complex skills. And as such, no high skill is dependent on just one cognitive variable. Furthermore, since this research is comparing two samples, the analysis needs to show the reader that the comparison is taking place on similar factors between the groups. Therefore, to ensure that similar components are present in the demographics, a FA was run using principal component analysis with a varimax rotation. The PCA was run on data which removed any extreme outliers in terms of low conceptual level response in the WCST (please refer to Chapter 5 for details).

After running the PCA, the reliability for each component was assessed and each component was discussed descriptively to compare the two samples. Any differences noted between the two samples descriptively were assessed for significance using a *Multivariate Analysis of Variance* test. Power was not tested for the ECF as the KMO and Bartlett results provided insight if the sample size was significant.

## 4.8 Ethical Considerations

### 4.8.1 Harm and Benefits.

The five ethical principles in psychological practice (i.e. *Autonomy, nonmaleficence, beneficence, justice, and fidelity*) are seen as the foundation of functioning at the highest ethical level as a professional (Corey, Corey, Corey, & Callanan, 2015, p. 17), of which four of the relevant principles were applied for protection of the participant's rights within this research.

*Autonomy* refers to respecting the diversity of individuals and ensuring that their sovereignty remains that of their own and that each individual has the freedom of choice (Corey et al., 2015). Keeping in line with the principle, participants were given a choice to participate in the data collection and were in no way forced to participate.

*Nonmaleficence* requires the researcher to consider what is in the best interest of the participant(s) and does not cause or lead to any harm (Allen, 2011). This study dealt with a vulnerable interest group of

youth in contravention with the law, placed in Youth Secure Care Centres (YSCC) at the time of data collection. As such, the possibility of the YSCC participant(s) experiencing negative feelings while completing the survey questions regarding family and home had been considered. However, ethical regulations of the YSCC only allow YSCC inhabitants to consult with their case managers if they feel emotionally distressed. To keep in line with the principle of non-maleficence, the researcher confirmed the availability of the case managers of all respective participants and the YSCC participants were verbally informed of the availability of their case managers. Additionally, to allow the school participants the same opportunity to reach out for emotional support, permission had been obtained from LifeLine (see Appendix P). SADAG did not require a permission letter as they are a toll-free counselling line whose numbers are generally available to public and schools in the area of interest. The numbers for both SADAG and LifeLine were provided in the information letters addressing the parents and school participants.

*Justice* refers to remaining conscious of ensuring that a trust relationship is upheld and by subscribing to various regulatory and legislative requirements (Corey et al., 2015). Hence, no personal information regarding any of the participants was disclosed in the study findings report. Anonymity from the public has been upheld by assigning unique roll numbers to all tests completed on the system, ensuring that other than the researcher, no other individual can identify the participants' results. All personal information was stored on a computer which is password protected and only accessible by the researcher. Additionally,

*Fidelity* entails being truthful (Allen, 2011). Upon obtaining ethical clearance, and with the necessary permissions from the Department of Social Development (i.e. DSD; see Appendix Q) and Department of Education (see Appendix R), relevant parties will be provided with a summarised report of the study results.

Additionally, concerns for the researcher's safety were raised to the SGD, in which they responded that safety measures are in place for researchers and visitors (see correspondence in Appendix S).

### 4.8.2 Informed Consent.

The APA defines informed consent as the process by which researchers describe their research project to their human participants and obtain consent to participate in the research based on the participants' understanding of the project ("Ethics Code of the American Psychological Association", 2014). Due to the study dealing with adolescents and vulnerable samples, the study required informed assent from the participants (see appendix N) as well as informed consent from all respective third parties caring for the participants (i.e. parents/ guardians/ youth centres/ government department/ schools; see Appendix O).

To obtain informed consent, the participants and related parties were provided with the following information: (1) The purpose of the research, procedures of data collection and duration of the data collection tasks; (2) Participants' right to decline to participate in the research as well as his right to withdraw from the research once participation has begun; (3) There are no penalties for refusing to participate or to withdraw; (4) There are no direct benefits for participation; (5) Participants were informed that there is no compensation for participation; and (6) Researcher's contact details were provided for any questions about the research and research participants' rights; (7) Participants were informed that all their information will be dealt with in confidentiality and their identity will remain anonymous. (8) Non-convicted participants were informed that consent is required from their guardian/parent, while convicted participants were informed that consent was received from the youth centres they are currently living in. Lastly, the voluntary nature of participation was explicitly expressed both verbally and in written format.

### 4.8.3 Consideration of Government Departments.

To invite and test young males who were convicted of a crime, the researcher received permission from the Department of Social Development (DSD) and the three YSCC's in Gauteng for access to sentenced and divergent youth. The permission was requested from the DSD and YSCC's as they have legal guardianship over sentenced youth in their care, as per the regulation of the Child Justice Act No. 75 of

2008. After having contacted the Department of Social Development (DSD) head office, it had been confirmed that the youth convicted of being in conflict with the law are under the jurisdiction and guardianship of the department (see appendix Q and appendix A). Therefore, all guardian-related permissions and parental consent were requested from the DSD to conduct the research. Additionally, permission was granted from the two Secure Care Centres chosen for research purposes (see Appendix U and V)

Since the study required the use of computer facilities, the Government Department of Education (GDE) was contacted to gain permission to conduct the study on school premises. GDE protocol was followed and research was only conducted once permissions had been received from the GDE (Appendix R), Education districts of choice (Appendix T) and schools of choice (Appendix W).

# Chapter 5: Results

## 5.1 Introduction

The results of the empirical study are presented and interpreted in this chapter. All statistical analyses were run using the viable data sample of 42 YSCC participants and 64 School participants.

## 5.2 Personal Information Questionnaire

The following section summarises the results of the self-report personal information questionnaire, which collected categorical data in the nominal and ordinal format.

The sampling criteria findings have been summarized in frequency tables mentioned above in Section 4.3, and so will not be restated within this section. The following results section summarizes findings in a descriptive format. Findings are presented in frequency tables, however, due to the difference in sample size, percentages are used to discuss comparative differences or similarities between groups.

Additionally, in an attempt to answer the first research question, the categorical data collected is compared using Pearson's Chi-square test. The Chi-square statistic is a non-parametric tool designed to analyse associations between two independent categorical variables (such as the information collected using the self-report questionnaire; Field, 2013; McHugh, 2013). Considering that the nature of the Chi-square test is similar to non-parametric tools (McHugh, 2013), parametric assumptions of normality or homogeneity are not tested for the categorical data collected.

### 5.2.1 Demographic Findings Between Groups

The age distributions between the samples vary due to the number of participants which were viable for further analysis within each sample group. For ease of reading, the age frequency table (*Table 4.4.)* is restated below. Looking at the age distribution percentages, a large difference is viewed within the number of 14-year age group participants (viable for test comparison purposes) between the sample groups (the school sample data constitutes of 24.9% more 14-year olds). Slight variations are seen within the age groups of 15-16 years, with a more prominent difference in sample percentage for the

age group of 17 years (only 26.2% of the YSCC sample is composed of 17-year olds data, whereas 36.6% of the school sample group is composed of 17-year olds).

*Table 5. 1: Age Distribution of the Viable Sample Group Numbers*

| Characteristic | Interest Group (YSCC) | | Contrast Group (School) | | |
|---|---|---|---|---|---|
| | Frequency | Percentage | Frequency | Percentage | N |
| **AGE** | | | | | |
| 14 | 2 | 4.8 | 19 | 29.7 | 21 |
| 15 | 13 | 31.0 | 14 | 21.9 | 27 |
| 16 | 16 | 38.1 | 14 | 21.9 | 30 |
| 17 | 11 | 26.2 | 17 | 36.6 | 29 |
| **Group Total** | **42** | **100.0** | **64** | **100.0** | **106** |

Looking at the similarities between groups with regards to language proficiency, *Table 5.2.* below indicates that in both samples, majority of the participants are proficient in English as a secondary language (74,5% of the entire sample) and approximately 25,5% of the sample shows proficiency in Zulu. Additionally, the majority of the participants in both samples speak two or more languages, where 78% of all the participants are proficient in two to three languages. The differences noted between the two sample groups in terms of language proficiency are that about 3 boys from the school sample group (4.7%) can speak a few more additional languages than the YSCC participant group. Referring to the table presented below, the two comparative sample groups appear to be similar in terms of language proficiency.

*Table 5. 2: A Frequency Table of Language Proficiency Representation Between the Two Sample Groups*

| Characteristic | Interest Group (YSCC) | | Contrast Group (School) | | |
|---|---|---|---|---|---|
| | Frequency | Percentage | Frequency | Percentage | N |
| **Additional Language Proficiency** | | | | | |
| English | 32 | 76.2 | 47 | 73.4 | 79 |
| Afrikaans | 6 | 14.3 | 15 | 23.4 | 21 |
| Setswana | 3 | 7.1 | 2 | 3.1 | 5 |
| Sesotho | 5 | 11.9 | 15 | 23.4 | 20 |
| Isizulu | 11 | 26.2 | 16 | 25.0 | 27 |
| Sepedi | 1 | 2.4 | 4 | 6.3 | 5 |
| Xhosa | 4 | 9.5 | 4 | 6.3 | 8 |
| Venda | 0 | 0.0 | 3 | 4.7 | 3 |
| Tsonga | 3 | 7.1 | 0 | 0.0 | 3 |
| Non-RSA | 0 | 0.0 | 1 | 1.6 | 1 |
| **Number of Languages they can speak proficiently** | | | | | |
| 1 | 2 | 4.8 | 3 | 4.7 | 5 |
| 2 | 20 | 47.6 | 34 | 53.1 | 54 |
| 3 | 15 | 35.7 | 14 | 21.9 | 29 |
| 4 | 4 | 9.5 | 9 | 14.1 | 13 |
| 5 | 1 | 2.4 | 1 | 1.6 | 2 |
| 6 | 0 | 0.0 | 2 | 3.1 | 2 |
| 7 | 0 | 0.0 | 1 | 1.6 | 1 |
| **Group Total** | **42** | **100.0** | **64** | **100.0** | **106** |

*Table 5.3.* (below) provides a summarized review of the education background between the two sample groups. More than half the participants in each sample group were educated in English as their first language. Discrepancies within the section of *Language of Education* arise due to the sampling procedure for school participants not being randomised. As such, it is expected to see that most school participants will indicate English as their language of education, while there are variations present within the YSCC sample group.

Comparisons cannot be made on the criteria of *Highest Grade Passed* as the school sample consisted of boys from grades 8 – 11, which is concurrent with the responses below. However, it is interesting to note that 57.2% of the YSCC sample have not studied beyond Grade 7 or 8. A notable descriptive is

also the apparent difference in the number of participants of YSCC who have completed Grade 10 (11.9%) are notably fewer than the school participants (39.1%).

*Table 5. 3: Language of Education and Level of Education*

| Characteristic | Interest Group (YSCC) | | Contrast Group (School) | | |
|---|---|---|---|---|---|
| | Frequency | Percentage | Frequency | Percentage | N |
| **Language of Education at School** | | | | | |
| English | 23 | 54.8 | 52 | 81.3 | 75 |
| Afrikaans | 5 | 11.9 | 1 | 1.6 | 6 |
| Other RSA | 4 | 9.5 | 3 | 4.7 | 7 |
| Languages | | | | | |
| English & Afrikaans | 2 | 4.8 | 3 | 4.7 | 5 |
| English & Other RSA | 6 | 14.3 | 5 | 7.8 | 11 |
| Languages | | | | | |
| I prefer not to respond | 2 | 4.8 | 0 | 0.0 | 2 |
| Group Total | 42 | 100.0 | 64 | 100.0 | 106 |
| **Highest Grade Passed** | | | | | |
| Gr 5 | 1 | 2.4 | 0 | 0.0 | 1 |
| Gr 6 | 2 | 4.8 | 0 | 0.0 | 2 |
| Gr 7 | 13 | 31.0 | 6 | 9.4 | 19 |
| Gr 8 | 8 | 19.0 | 22 | 34.4 | 30 |
| Gr 9 | 6 | 14.3 | 11 | 17.2 | 17 |
| Gr 10 | 5 | 11.9 | 25 | 39.1 | 30 |
| I prefer not to respond | 7 | 16.7 | 0 | 0.0 | 7 |
| Group Total | 42 | 100.0 | 64 | 100.0 | 106 |

*Table 5.4.* provides a descriptive visual with regards to the similarities and differences between the two sample groups in terms of any trends that may be picked up on learning difficulties. Both sample groups indicate that almost half of the participants have failed a school grade at some point. Another similarity noted between groups is that approximately half of the participants in each sample group had failed or repeated one grade.

Differences can be noted between the sample groups where 39.1% of participants in the school sample indicate that they have never failed a grade, whereas 40.5% of YSCC participants have failed a grade

in *Senior Phase* of school. Additionally, more school participants repeated or failed at the *Further Education and Training (FET*) level. Lastly, no school participants reported having failed more than one grade, however, 19.0% of the YSCC participants had failed or repeated more than two grades.

*Table 5. 4: A Descriptive Table Comparing Possible Learning Difficulties Between Groups*

| Characteristic | Interest Group (YSCC) | | Contrast Group (School) | | |
|---|---|---|---|---|---|
| | Frequency | Percentage | Frequency | Percentage | N |
| **Ever Failed a Grade?** | | | | | |
| Yes | 25 | 59.5 | 37 | 57.8 | 62 |
| No | 15 | 35.7 | 26 | 40.6 | 41 |
| I prefer not to respond | 2 | 4.8 | 1 | 1.6 | 3 |
| Group Total | 42 | 100.0 | 64 | 100.0 | 106 |
| **School Phase in which Grade/s were Repeated or Failed.** | | | | | |
| Never repeated/failed | 11 | 26.2 | 25 | 39.1 | 36 |
| Foundation phase (Gr 0 – 3) | 4 | 9.5 | 5 | 7.8 | 9 |
| Intermediate Phase (Gr 4 – 6) | 6 | 14.3 | 3 | 4.7 | 9 |
| Senior Phase (Gr 7 – 9) | 17 | 40.5 | 14 | 21.9 | 31 |
| FET (Gr 10-12) | 2 | 4.8 | 12 | 18.8 | 14 |
| I prefer not to respond | 2 | 4.8 | 5 | 7.8 | 7 |
| Group Total | 42 | 100.0 | 64 | 100.0 | 106 |
| **Number of Repeated/Failed Grades** | | | | | |
| Never repeated/failed | 11 | 26.2 | 25 | 39.1 | 36 |
| Only 1 Grade | 21 | 50.0 | 34 | 53.1 | 55 |
| More Than 1 Grade | 8 | 19.0 | 0 | 0.0 | 8 |
| I prefer not to respond | 2 | 4.8 | 5 | 7.8 | **7** |
| Group Total | 42 | 100.0 | 64 | 100.0 | 106 |

*Table 5.5.* below provides comparisons for participants attitudes towards their self-reported competencies, approximately half of the participants in both sample groups believe they have good levels of concentration. Differences arise in the self-conception of memory where most of the YSCC participants (71.4%) report having good memory compared to only half of the school participants considering their memory to be "*Good"* and 42.2% consider their memory to be "*Average"*.

*Table 5. 5: Self-Report of Competency in Concentration and Memory Between the two Sample Groups*

| Characteristic | Interest Group (YSCC) | | Contrast Group (School) | | |
|---|---|---|---|---|---|
| | Frequency | Percentage | Frequency | Percentage | N |
| **Self-rating of Concentration** | | | | | |
| Good | 24 | 57.1 | 32 | 50.0 | 56 |
| Average | 14 | 33.3 | 30 | 46.9 | 44 |
| Weak | 4 | 9.5 | 1 | 1.6 | 4 |
| I prefer not to respond | 0 | 0.0 | 1 | 1.6 | 1 |
| Group Total | 42 | 100.0 | 64 | 100.0 | 106 |
| **Self-rating of Memory** | | | | | |
| Good | 30 | 71.4 | 34 | 53.1 | 64 |
| Average | 8 | 19.0 | 27 | 42.2 | 35 |
| Weak | 2 | 4.8 | 1 | 1.6 | 3 |
| I prefer not to respond | 2 | 4.8 | 2 | 3.1 | 4 |
| Group Total | **42** | **100.0** | **64** | **100.0** | **106** |

Risk-taking behavioural pattern comparisons indicate that almost half the school sample have tried alcohol at some point, and more school participants (23.4%) than YSCC participants (11.9%) have never tried alcohol. Comparatively, more YSCC participants drink often (23.8%) whereas only 6.3% of school participants report to drink often.

A larger difference is seen for a drug-use behavioural pattern where 75% of school participants report to have never tried any form of drugs, compared to YSCC participants where 28.9% have tried drugs, 28.9% use drugs socially and 26.2% of the participants use often.

*Table 5. 6: Risk-Taking Behaviour Patterns Between the Two Sample Groups*

| Characteristic | Interest Group (YSCC) | | Contrast Group (School) | | |
|---|---|---|---|---|---|
| | Frequency | Percentage | Frequency | Percentage | N |
| **Alcohol Consumption** | | | | | |
| Not at all | 5 | 11.9 | 15 | 23.4 | 20 |
| I have tried it | 13 | 31.0 | 30 | 46.9 | 43 |
| I drink socially only | 13 | 31.0 | 11 | 17.2 | 24 |

| | | | | | |
|---|---|---|---|---|---|
| I drink often | 10 | 23.8 | 4 | 6.3 | 14 |
| I prefer not to respond | 1 | 2.4 | 4 | 6.3 | 5 |
| Group Total | 42 | 100.0 | 64 | 100.0 | 106 |
| **Drug Use** | | | | | |
| Not at all | 4 | 9.5 | 48 | 75.0 | 52 |
| I have tried it | 12 | 28.6 | 8 | 12.5 | 20 |
| Socially only | 12 | 28.6 | 2 | 3.1 | 14 |
| I use often | 11 | 26.2 | 2 | 3.1 | 13 |
| I prefer not to respond | 3 | 7.1 | 4 | 6.3 | 7 |
| **Group Total** | **42** | **100.0** | **64** | **100.0** | **106** |

Looking at the family background, the two sample-groups have certain similarities in terms of family incarceration history (almost half from both sample groups say No), whether or not they are the eldest child (Less than 40% say they are the eldest), the number of people they live within their home (more than 70% say 6 or less). The difference between the groups is seen in their caregiver history. Approximately 70.3% school-going children were reported to have the same caregiver throughout their schooling phases (pre-school, primary school and high school), whereas only 40.5% YSCC participants were reported to have the same caregiver throughout their schooling life.

*Table 5. 7: Living Environment and Caregiver Background*

| Characteristic | Interest Group (YSCC) | | Contrast Group (School) | | |
|---|---|---|---|---|---|
| | Frequency | Percentage | Frequency | Percentage | N |
| **How many people live in your home?** | | | | | |
| <4 | 17 | 40.5 | 26 | 40.6 | 43 |
| 4 – 6 | 13 | 31.0 | 22 | 34.4 | 35 |
| 6 – 8 | 4 | 9.5 | 12 | 18.8 | 16 |
| >8 | 6 | 14.3 | 2 | 3.1 | 8 |
| I prefer not to respond | 2 | 4.8 | 2 | 3.1 | 4 |
| Group Total | 42 | 100.0 | 64 | 100.0 | 106 |
| **Same Caregiver through pre-school, primary school and high school.** | | | | | |
| Yes | 17 | 40.5 | 45 | 70.3 | 62 |
| No | 25 | 59.5 | 19 | 29.7 | 44 |
| Group Total | 42 | 100.0 | 64 | 100.0 | 106 |
| **Is someone in your family incarcerated?** | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| Yes | 19 | 45.2 | 31 | 48.4 | 50 |
| No | 19 | 45.2 | 32 | 50.0 | 51 |
| I prefer not to respond | 4 | 9.5 | 1 | 1.6 | 5 |
| Group Total | 42 | 100.0 | 64 | 100.0 | 106 |
| **Are you the eldest child?** | | | | | |
| Yes | 15 | 35.7 | 25 | 39.1 | 40 |
| No | 26 | 61.9 | 37 | 57.8 | 63 |
| I prefer not to respond | 1 | 2.4 | 2 | 3.1 | 3 |
| Group Total | 42 | 100.0 | 64 | 100.0 | 106 |
| **Does your family employ a domestic worker?** | | | | | |
| Yes | 7 | 16.7 | 2 | 3.1 | 9 |
| No | 35 | 83.3 | 62 | 96.9 | 97 |
| Group Total | 42 | 100.0 | 64 | 100.0 | 106 |

### 5.2.2 Chi-Square Comparisons Between Groups

Given the abovementioned differences noted in the frequency of reported difficulties in learning (i.e. the phase within which grades were repeated or failed, as well as the number of grades repeated or failed), the reported differences in risk-taking behaviour and whether or not they were cared for by the same caregiver throughout their school life, further testing was done to answer the research question regarding demographic factor similarity and differences.

Chi-square tests were run to test if the differences in the abovementioned variables showed a significant level of association to the group the data was collected from. Due to the small sample used for comparisons, Fischer's exact test was used to test for significance, as it is reported to be more accurate than the chi-square test or G–test of independence when the expected numbers are small (McDonald, 2015). As described by Field (2013), Fisher's exact test (Fisher, 1922) is not a test, but rather a way of computing the exact probability of a statistic of a small sample distribution. The Fisher's exact test procedure is normally used on 2 × 2 contingency tables, however, Field (2013) suggests that it can be used on larger contingency tables, as long as the sample is not too large to become computationally extensive on SPSS. Following suggested theory Field (2013), for the 2x2 contingency tables, Yates

Continuity Correction is reported on for the comparison between groups on whether or not they had the same caregiver throughout the phases of their school.

All chi-square test scores were followed with a strength of association statistic, as advised by (McHugh, 2013). This strength statistic modifies the chi-square statistic by taking into account the sample size and degrees of freedom (df), it then restricts the range of the test statistic from 0 to 1 (to make them similar to the Pearson's correlation coefficient, r) (Field, 2013). The strength of the association test in this instance is used to assess the direction of the association, as well as an indication of effect size (Field, 2013). Cramer's V can be assessed as an adequate effect size, which is an objective and standardized measure of the magnitude of an observed effect (Field, 2013) as measures used to assess effect size include Cohen's d, Glass' g and Pearson's correlations coefficient, r (or in the instance of a chi-square test, the strength of association test) (Field, 2013; McHugh, 2013).

The Cramer's V is the most common measure of strength association test (McHugh, 2013), used to test the data when a significant Chi-square result has been obtained between two categorical variables, of which one of the variables has more than two categories (Field, 2013). Cramer's V is a variant of *Phi* (a strength of association test used for 2x2 contingency tables) used because Phi fails to reach its minimum value of 0 (indicating no association) when one or both of the categorical variables contain more than two categories (Field, 2013; McHugh, 2013).

Independent categorical data was used for the analysis and only results with no more than 20% of cells having less than the minimum expected count of 5 (Field, 2013) are reported below. The variables for questions "*Ever failed a grade?",* "*Phase in which grade is repeated/failed"* and "*Family incarceration history"* did not meet the minimum expected frequency of 5 in 20% of the cells or less, as such their chi-square results are not reported.

*Table 5. 8: Chi-square Results of Viable Tests*

| Variables Tested | Chi-Square Test | | | Strength of Association Test | | | Standardized Statistic |
|---|---|---|---|---|---|---|---|
| | Test Typed | Value | Sig. | Test Type | Value | Sig. | |
| Sample Group & Alcohol | Fischer's Exact | 11.682 | **0.016*** | Cramer's V | 0.340 | **0.013*** | 0.769 |
| Sample Group & Drug Use | Fischer's Exact | 52.857 | **0.000**** | Cramer's V | 0.681 | **0.000**** | -0.464 |
| Sample Group & Same Caregiver | Continuity Correction (2x2 Table) | 8.110 df (1) | **0.004*** | Phi | -0.296 | **0.002*** | **-3.035** |
| Sample Group & No. of People living in home | Fischer's Exact | 5.800 | 0.120 | Cramer's V | 0.244 | 0.105 | -0.617 |

* $p < 0.05$ ** $p < 0.001$

Demographic factors that significantly indicate a difference between groups are alcohol consumption behaviour ($\chi^2 = 11.682$, $p < 0.05$), drugs use ($\chi^2 = 52.857$, $p < 0.001$) and whether the participant had the same caregiver throughout their childhood and schooling phases ($\chi^2$ (1) = 8.110, $p < 0.05$).

Looking at the effect size (i.e. Cramer's V) the use of drugs indicates a fairly good effect size, suggesting that the observed use of drugs is a significant demographic factor that can differentiate between individuals who are at risk of criminal capacity.

Crosstabulation of the number of grades repeated or failed with the sample group or with the variable of the same caregiver could not be reported as the results did not meet the assumption of less than 20% of the cells meet an expected count of less than 5.

## 5.3 Emotional Intelligence Scale

### 5.3.1 Introduction

The following section reports on the Emotional Intelligence results of the sample of 42 YSCC participants and 63 School participants. One of the school participant's data is excluded due to language issues.

All statistical analyses are run in line with the descriptive research design, as such, within-group developmental trajectories of mean scores are plotted for a visual description of between-group differences. Additionally, due to the exploratory nature of the research itself, basic inferential statistical analyses are run for between-group comparison. The analysis summarised in this section attempt to answer the following research questions mentioned in section 4.1.

1. What level of EI do the convicted individuals display?
2. Does this level of EI differ *significantly* between the comparative sample groups?

The section tests for the EI scale's reliability score on the South African adolescent males and the assumptions of parametric tests. Descriptive statistics are reported in terms of mean scores between groups, as well as within-group scores per age group. Thereafter, mean comparison independent sample t-tests are reported on for any significant differences observed between groups. All statistical tests for the individual items are run using the reverse scores for items 5, 28 and 33.

### 5.3.2 Reliability of the Scale

A reliability test gives a statistical score of the ability of a measure to produce consistent results when the same entities are measured under different conditions (Field, 2013). Field (2013) notes that although the generally accepted value of .8 is appropriate for cognitive tests such as intelligence tests, for ability tests a cut-off point of .7 is more suitable.

*Table 5. 9: Reliability Statistics of the SSEIT for data of the entire sample (N = 105)*

| Cronbach's Alpha | Cronbach's Alpha Based on Standardized Items | N of Items |
|---|---|---|
| .864 | .871 | 33 |

*Table 5. 10: Reliability Statistics of the SSEIT for data from each sample group*

| Group | Cronbach's Alpha | Cronbach's Alpha Based on Standardized Items | N of Items |
|---|---|---|---|
| YSCC | .821 | .831 | 33 |
| School | .877 | .884 | 33 |

*Table 5.9.* (above) indicates a Cronbach α > 0.8 for the entire sample group from which data was collected (*N = 105),* which is considered an appropriate score for when using cognitive tests (Kline, 1999). The reliability score was further tested separately for the two sample groups to confirm if the scale could reliably determine the EI level of participants in the two comparative samples. The Cronbach α is again reported to be greater than 0.8 (*Table 5.10.)* and as such can be considered an adequate test for determining the EI level between groups.

The Cronbach α score was tested for each item of the scale (33 items). *Table 5.3.2.3* (see Appendix U) indicates what the Cronbach α score would be if the item were deleted. In the case of the entire sample, as well as for the two different sample groups, the Cronbach α results suggest that the test reliability would improve at the deletion of Question 33, which asks for a response score on the following, "*It is difficult for me to understand why people feel the way they do*".

### 5.3.3 Testing Assumptions for Parametric Tests

Parametric mean comparisons between groups require that certain assumptions be met. Specifically, to run independent-samples t-tests, the data must be interval/ratio, no significant outliers must be present, assumptions of normality need to be satisfied and the samples must assume homogeneity of variance (Field, 2013).

#### *5.3.3.1 Testing for Outliers.*

The data is first checked for outliers using visual methods (i.e. boxplots). The boxplot visually represents the data in terms of the median (a horizontal line inside the box) and the interquartile range (as the length of the box). The whiskers (line extending from the top and bottom of the box) represent

the minimum and maximum values when they are within 1.5 times the interquartile range (IQR) from either end of the box. Scores greater than 1.5 times the IQR are visually represented outside of the boxplot as outliers (Ghasemi & Zahediasl, 2012). For the entire sample of N = 105 participants, one 15-year old adolescent male's SSEIT total score for EI (from the YSCC group) is shown as an outlier. This participant scored the lowest for EI with a total score of 80 (see *Table 5.11*below for reference). Due to the participant being noted as an outlier, all further statistical analyses were run after removing the outlier. *Table 5.12.* below notes the changes in variance, range and IQR after the removal of the outlier participant's score.

*Table 5. 11: General Descriptive Statistics of the Entire Sample for the Total SSEIT Score*

| Mean | Variance | S.D. | Minimum | Maximum | Range | IQR | Skewness | Kurtosis |
|---|---|---|---|---|---|---|---|---|
| 124.37 | 218.947 | 14.797 | 80 | 158 | 78 | 20 | -0.283 | 0.257 |

*Table 5. 12: General Descriptive Statistics of the Entire Sample for the Total SSEIT Score – after Removal of the outlier score*

| Mean | Variance | S.D. | Minimum | Maximum | Range | IQR | Skewness | Kurtosis |
|---|---|---|---|---|---|---|---|---|
| 124.80 | 201.774 | 14.205 | 88 | 158 | 70 | 19 | -0.113 | -0.082 |

#### *5.3.3.2 Normality Distribution.*

Normality tests and Levene's test of homogeneity of variance were run on the data for the entire sample, as well as for the separate sample groups. The data collected from the entire sample is not significant for both tests of normality (i.e. Kolmogorov- Smirnov and the Shapiro Wilk; see *Table 5.13.*), as such it can be determined that the sample data meets the assumption of a normal distribution of results. Additional normality distribution tests were run for the two sample groups separately. The results (summarized in *Table 5.14* below) indicate that each sample group's SSEIT scores also follow a normal distribution curve, and as such within-group comparisons using parametric tests may be possible.

The Kolmogorov- Smirnov test is an empirical distribution function (Ghasemi & Zahediasl, 2012); however, it has a limitation to its effectivity due to its high sensitivity to extreme values (Peat & Barton,

2008). The Lilliefors correction renders the K-S test less conservative (Peat & Barton, 2008). Ghasemi & Zahediasl (2012) report that the K-S test has low power and should be considered with caution when testing normality. Comparatively, the Shapiro-Wilk test is a formal normality test which is commonly used and exhibits good power properties (Razali, & Wah, 2011). The normality test is an effective measure of normality in small samples (Shapiro & Wilk, 1965), where significant results 0.05 or less indicate that assumptions of normality have not been met (Razali & Wah, 2011; Shapiro & Wilk, 1965).

*Table 5. 13: Normality Test of the Final SSEIT Score for the Entire Sample, Post removal of an outlier (N = 104)*

| | Kolmogorov-Smirnov[a] | | | Shapiro-Wilk | | |
|---|---|---|---|---|---|---|
| | Statistic | df | Sig. | Statistic | df | Sig. |
| Total EI Score | .063 | 104 | 0.200* | 0.993 | 104 | 0.879 |

*. This is a lower bound of the true significance.
a. Lilliefors Significance Correction

*Table 5. 14: Normality Distribution of the Final SSEIT Score Between the Two Sample Groups (N = 104)*

| Sample Group | | Kolmogorov-Smirnov[a] | | | Shapiro-Wilk | | |
|---|---|---|---|---|---|---|---|
| | | Statistic | df | Sig. | Statistic | df | Sig. |
| YSCC | Total EI Score | .090 | 41 | 0.200* | 0.980 | 41 | 0.677 |
| School | Total EI Score | .082 | 63 | 0.200* | 0.985 | 63 | 0.655 |

*. This is a lower bound of the true significance.
a. Lilliefors Significance Correction

Histograms of the normality curve were viewed for the visual description of the two sample's data, respectively. The histograms indicated that the YSCC sample data followed a normal distribution curve (see Figure 5.1 below), however, the school sample's data seemed to follow a binomial distribution in their results of the SSEIT (see figure 5.2 illustrating school participant scores in the histogram below).

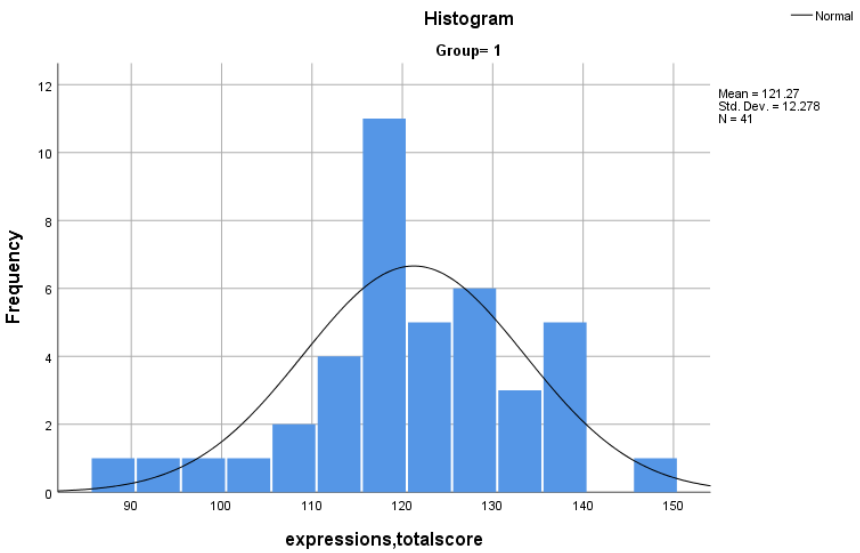



*Figure 5. 1: Normal Distribution Curve of YSCC Participants' Results for the SSEIT*

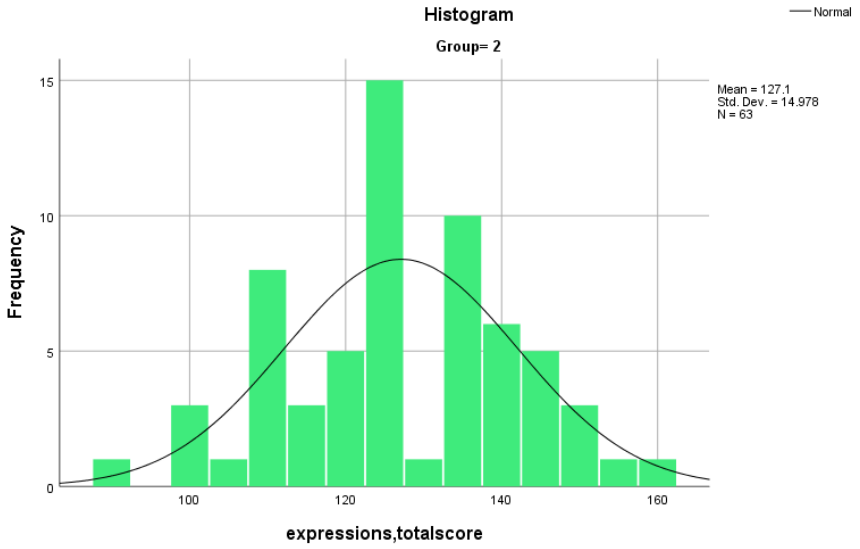



*Figure 5. 2: Normal Distribution Curve of School Participants' Results for the SSEIT*

Due to the normality tests not being significant (i.e. data follows a normal distribution for both samples), the skewness and kurtosis being within a reasonable range (see *table 5.15* below), and the histograms for both sample groups (and the entire sample of *N = 104*) looking reasonably in line with the normal distribution curve, the assumption of a normal distribution is confirmed for further statistical testing.

#### *5.3.3.3 Homogeneity of Variance (Levene's Test)*

Homogeneity of variance was tested using Levene's test as it is a statistical measure which tests the hypothesis that the variances in different groups are equal (Field, 2013). The Levene's test yielded non-significant results, $F = 2.556$; $p > 0.05$, for the SSEIT scores for each of the comparative sample groups (i.e. YSCC sample and school sample). As such, the results confirm the homogeneity of variance of both independent sample groups due to insignificant results (Field, 2013; Howell, 2014), and independent samples t-test can be used for comparing the EI results from the two comparative samples.

Additionally, Levene's test of homogeneity was tested for each age group between the two sample groups. Nonsignificant results for Levene's test were found for the age groups of 14 years ($F = 0.038$; $p > 0.05$), 15 years ($F = 1.163$; $p > 0.05$) and 17 years ($F = 0.723$; $p > 0.05$) between the two comparative sample groups. However, the 16-year age group were found to have significant results for the Levene's test ($F = 4.525$; $p = 0.043$), as such homogeneity of variance is not present between the two sample groups at the age of 16 years. The abovementioned findings confirm the homogeneity of variance in the entire sample group, as well as within each age-group between the two comparative sample groups, except for the age group of 16-year-old participants. Therefore, t-tests can be used for comparative analysis between the sample groups as a whole and per age group.

### 5.3.4 Descriptive Statistics

The following section summarizes in table format the mean scores of the participants between the YSCC sample group (*N = 41)* and the school sample group (*N = 63)*. Additional descriptive statistics relating to the SSEIT total scores are also summarised in the tables below.

As summarized in *tables 5.15 and 5.16* below, the YSCC participants on average scored lower than the school participants in the emotional intelligence scale. A general trend in the mean scores per age group also indicates that YSCC participants score slightly less than school participants on average, except for the age group of 16-year-olds, where there seems to be a greater difference present. Figure 5.3 below provides a visual trend of the developmental trajectory of EI of the two comparative sample groups. The figure provides a visual depiction of the average EI level of each age-group between the

two comparative sample groups. Additionally, the average score of each question between the two sample groups is summarized in *Table 5.3.4.3* (placed within Appendix U). Looking at the average scores of each SSEIT item between groups, the scores seem to follow the abovementioned trend of YSCC participants scoring slightly lower than the school participants. Greater differences in average scores were seen between items 3, 16, 19, 23, 28 and 31. For details, please refer to table *5.3.4.3* in Appendix U.

An additional interesting observation is that there seems to be greater variance within the school sample results, due to the greater range in the sample's scores. The same trend of increased variance (i.e. spread of scores deviating from the mean (Christensen, Johnson & Turner, 2014)) of scores is observed for each of the age groups between the two sample groups. The variance of the age group of 14-years for the YSCC sample is not considered in this case due to the very low number of participants in the sample group (*N = 2).*

*Table 5. 15: Descriptive Statistics of the Two Comparative Sample Groups' SSEIT Score*

| Group | Mean | Variance | Std. Deviation | Minimum | Maximum | Range | Skewness | Kurtosis |
|---|---|---|---|---|---|---|---|---|
| YSCC | 121.27 | 150.751 | 12.278 | 88 | 149 | 61 | -0.374 | 0.750 |
| School | 127.10 | 224.346 | 14.978 | 90 | 158 | 68 | -0.185 | -0.380 |

*Table 5. 16: Descriptive Statistics of each Age Group Between the Two Comparative Sample Groups' SSEIT Score*

| Age | Sample Group | N | Mean | Std. Deviation | Std. Error Mean | Minimum | Maximum |
|---|---|---|---|---|---|---|---|
| **14** | YSCC | 2 | 130.00 | 14.142 | 10.000 | 120 | 140 |
| | School | 19 | 129.79 | 11.429 | 2.622 | 102 | 146 |
| **15** | YSCC | 12 | 125.42 | 10.211 | 2.948 | 109 | 140 |
| | School | 14 | 125.93 | 15.479 | 4.137 | 99 | 150 |
| **16** | YSCC | 14 | 116.29 | 11.411 | 3.050 | 95 | 136 |
| | School | 13 | 131.85 | 17.771 | 4.929 | 108 | 158 |
| **17** | YSCC | 13 | 121.46 | 13.794 | 3.826 | 88 | 149 |
| | School | 17 | 121.41 | 15.112 | 3.665 | 90 | 147 |

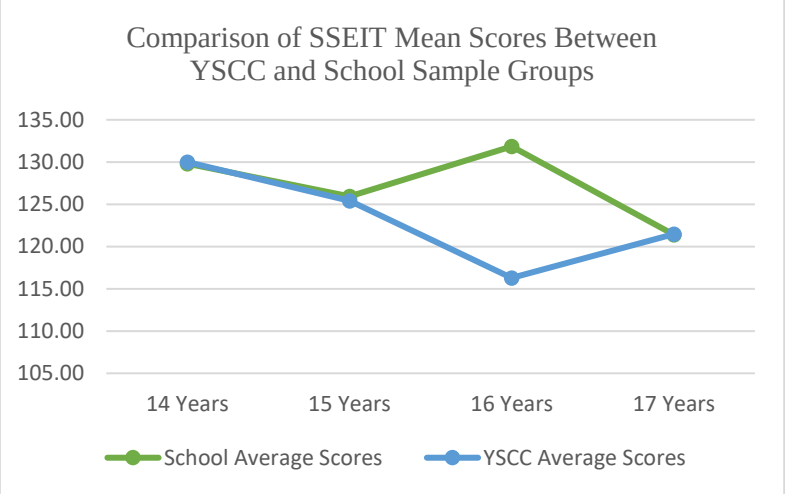



*Figure 5. 3: EI Developmental Trend between the two Sample Groups (N = 104)*

### 5.3.5 Mean Comparisons Between Sample Groups of SSEIT Scores

The abovementioned sections address the descriptive EI levels of both sample groups as well as the EI developmental trend between the two sample groups according to the mean scores per age-group. For further exploration of the abovementioned descriptive data, independent samples t-tests were run to compare if differences seen between the two samples are significant.

Mean comparisons were conducted on three levels. The first mean comparison table (*Table 5.17*) compared the average EI score between the YSCC and School sample groups as a whole and yielded

significant results; *t (102) = -2.077, p < 0.05*. The second mean comparison table (*Table 5.18*) summarizes the comparative differences between the two sample groups according to each age-group tested. The second mean comparisons table summarizes a significant difference is only present for the 16-year-old age group; *t (20.213) = -2.685, p < 0.05*. The selected age-group, however, does not assume homogeneity of variance (F = 4.525; p < 0.05). The third level of mean comparison took place at the individual item level (all results summarized in Appendix U in *Table 5.3.5.4*), from which 5 items yielded significant differences between the two sample groups (see *Table 5.19*).

*Hedges' g* is reported as an effect size indicator for each of the t-test analysis (reported in the tables below). Like Cohen's d, Hedges g is an effect size measure of mean comparisons between two groups (Howell, 2014). Cohen's d is considered a more appropriate effect size indicator for two groups which have the same sample size and have similar standard deviations (Field, 2013; Howell, 2014). Alternatively, Hedges' g is a more appropriate effect size indicator if the two comparative samples have different sample sizes and reported standard deviations as it measures effect size weighted according to each sample's relative size (Ellis, 2010; Howell, 2014). Additionally, in sample sizes smaller than 20, Hedges' g is reported to outperform Cohen's d and as such (Ellis, 2010), Hedges' g should be chosen for small sample sizes.

Looking at the mean comparisons, the difference in EI between the two groups is significant. Reporting on the moderate effect size (g = 0.42), it can be concluded that EI has a moderate effect on the difference between the sample groups.

*Table 5. 17: Mean Comparison of Total SSEIT Score Between the Two Sample Groups using Independent Samples T-test*

| | Independent Samples T-test | | | | | Effect Size | |
|---|---|---|---|---|---|---|---|
| | t | df | Sig. (2-tailed) | Mean Difference | Std. Error Difference | Cohens d | Hedges' g |
| Equal variances assumed | -2.077 | 102 | 0.**040** | -5.827 | 2.806 | 0.425712 | **0.416981** |

*Table 5. 18: Mean Comparisons Within each Age group Between the Two Comparative Sample Groups using Independent Samples T-test*

| Age | | Levene's Test | | Independent Sample T-test | | | | | Effect Size |
|---|---|---|---|---|---|---|---|---|---|
| | | F | Sig. | t | df | Sig. (2-tailed) | Mean Difference | Std. Error Difference | Hedges' g |
| **14** | Equal variances assumed | 0.038 | 0.847 | 0.024 | 19 | 0.981 | 0.211 | 8.614 | 0.018123 |
| **15** | Equal variances assumed | 1.163 | 0.292 | -0.098 | 24 | 0.923 | -0.512 | 5.242 | 0.038272 |
| **16** | Equal variances assumed | 4.525 | 0.**043** | -2.728 | 25 | 0.**011** | -15.560 | 5.704 | **1.05073** |
| | Equal variances not assumed | | | -2.685 | 20.213 | 0.**014** | -15.560 | 5.796 | |
| **17** | Equal variances assumed | 0.723 | 0.402 | 0.009 | 28 | 0.993 | 0.050 | 5.365 | 0.003434 |

*Table 5.18* (above) indicates that only the age group of 16-year olds do not meet the assumption of homogeneity of variance and it is the only age-group which yields significant difference between the mean scores of the two sample groups. A concerning observation, however, is that the effect size is >1, indicating that the difference between the two means is greater than one standard deviation (Ellis, 2010; Howell, 2014).

*Table 5.19* (below) summarizes the results of the five items (3, 16, 19, 23, 28R) which yield significant differences between the mean scores of the two comparative sample groups. Three of the items confirm the assumption of homogeneity if variance (items 3, 19, 23), whereas two of the five items (16 and 28R) do not meet the assumption for homogeneity of variance ($p < 0.05$). An interesting observation regarding the effect size is that the two items which do not meet the assumption for homogeneity of variance yield large effect size (> 0.6), similar to the large effect size observed in *Table 5.18* above.

*Table 5. 19: Significant Results of Independent Sample T-test Mean Comparison for Scale Items*

| | Levene's Test | | Independent Samples t-test | | | | | Hedges' g |
|---|---|---|---|---|---|---|---|---|
| | F | Sig. | t | df | Sig. (2-tailed) | Mean Difference | Std. Error Difference | |
| Q3: "*I expect that I will do well on most things I try."* | | | | | | | | |
| Equal variances assumed | 1,248 | 0,267 | -2,470 | 102 | **0,015** | -0,454 | 0,184 | 0.538044 |
| Q16: "*I present myself in a way that makes a good impression on others*." | | | | | | | | |
| Equal variances assumed | 7,517 | **0,007** | -3,709 | 102 | 0,000 | -0,690 | 0,186 | |
| **Equal variances not assumed** | | | -3,377 | 60,457 | **0,001** | -0,690 | 0,204 | 0.781413 |
| Q19: *"I know why my emotions change."* | | | | | | | | |
| Equal variances assumed | 2,643 | 0,107 | -2,012 | 102 | **0,047** | -0,449 | 0,223 | 0.439442 |
| Q23: "*I motivate myself by imagining a good outcome to tasks I take on*." | | | | | | | | |
| Equal variances assumed | 0,396 | 0,531 | -2,790 | 102 | **0,006** | -0,473 | 0,170 | 0.594637 |
| Q28_R: "*When I am faced with a challenge, I give up because I believe I will fail*." | | | | | | | | |
| Equal variances assumed | 9,702 | **0,002** | -5,094 | 102 | 0,000 | -1,103 | 0,217 | |
| **Equal variances not assumed** | | | -4,770 | 67,185 | **0,000** | -1,103 | 0,231 | 0.978237 |

Assessing the significance of the abovementioned items provides some valuable insights on the exact questions of their emotional intelligence. However, it does not indicate the average scores or mode of scores for the questions. *Table 5.20.* below summarizes the mean scores, standard deviation and mode for the SSEIT items which indicate significant differences between groups. For more details on the

mean item score trend across the developmental age-groups of 14-17 years between the two comparative samples, refer to the figures and descriptions below (*Figures 5.4 – 5.8)*.

*Table 5. 20: Descriptive Statistics of the 5 Items which indicate Significant Differences in Responses Between the Two Sample Groups*

| | Sample Group | Mean | Std. Deviation | Minimum | Maximum | Mode |
|---|---|---|---|---|---|---|
| Q 3 | YSCC | 3,88 | 1,109 | 1 | 5 | 4 |
| | School | 4,38 | 0,792 | 1 | 5 | 5 |
| Q 16 | YSCC | 3,67 | 1,183 | 1 | 5 | 4 |
| | School | 4,40 | 0,730 | 1 | 5 | 5 |
| Q 19 | YSCC | 3,45 | 1,194 | 1 | 5 | 4 |
| | School | 3,94 | 1,061 | 1 | 5 | 4 |
| Q 23 | YSCC | 3,74 | 0,989 | **1** | 5 | 4 |
| | School | 4,25 | 0,761 | **2** | 5 | 4 |
| Q 28 _R | YSCC | 3,38 | 1,287 | 1 | 5 | 4 |
| | School | 4,44 | 0,929 | 1 | 5 | 5 |

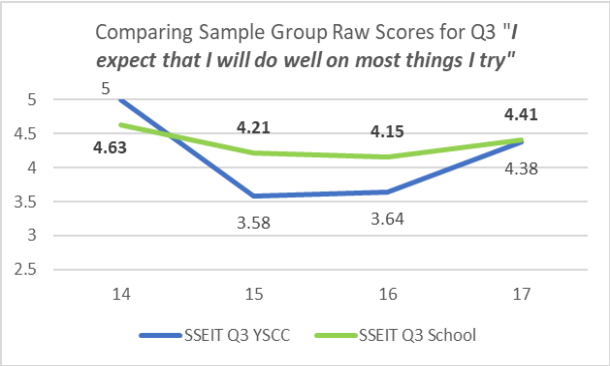



*Figure 5. 4*

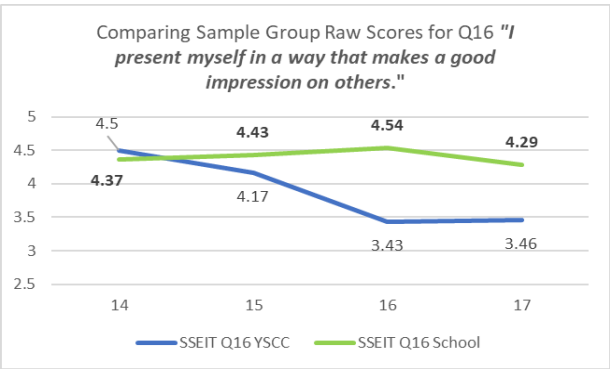



*Figure 5. 5*

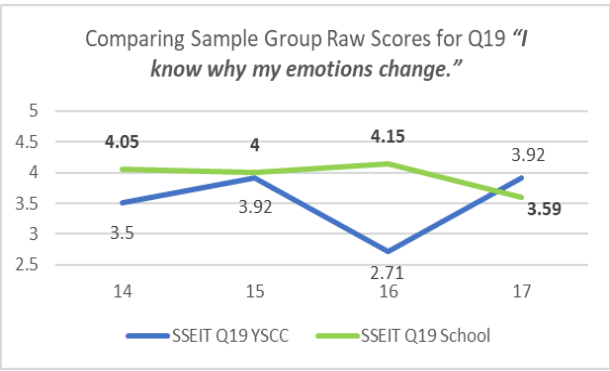



*Figure 5. 6*

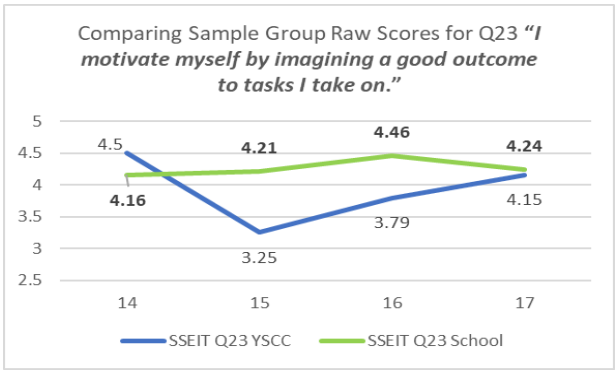



*Figure 5. 7*

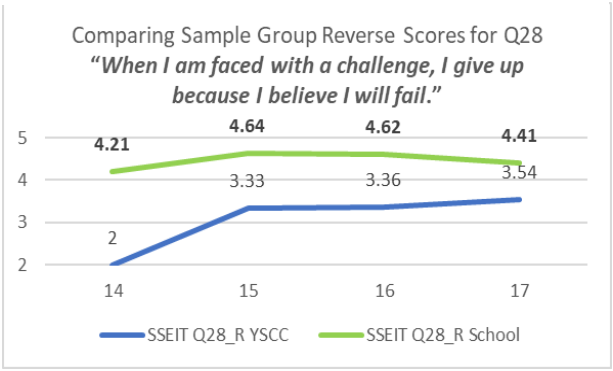



*Figure 5. 8*

The age-related scores between the two comparative samples are illustrated in *Figures 5.4–5.8.* An interesting observation is that only the 16-year YSCC cohort scored observably low for Q19, which indicates that the YSCC 16-year participants are not aware of why their emotions change. For Q28 (graph and all data reported on are reverse scored), all YSCC participants show low motivation to persist in the face of a challenge due to fear of failure (*Figure 5.8*, above). Q3 and Q23 indicate low EI scores for the 15 and 16-year YSCC cohorts regarding the expectation of self and self-motivation. Additionally, Q16 observes a decline in self-regulation to create good impressions on others from the age of 15 in the YSCC sample and Q28 (reverse scores represented, analysed and discussed) observes that the YSCC sample group scores less for persistence in the face of challenges, than the school sample, which can be an indicator for the entire YSCC sample's behaviour or attitude towards challenges and problems. Comparing the graphic

representations to the effect sizes reported in *Table 5.20* (above), the visual illustration of the EI developmental trend for the abovementioned SSEIT items confirms that Q28, which relates to persistence in the face of challenges, has the greatest effect size of 0.98 due to all the age-group between the two samples differing in their scoring. Additionally, the smallest effect size of 0.44 is observed for Q19, relating to self-awareness of emotions, which the graph verifies to be due to the difference only being observably present in the 16-year age group between the two samples. As such, the calculated effect size indicates a relation to the number of age-groups (14-17 years) which show an observable difference between the two comparative samples.

### 5.3.6 Power

Reporting on the retrospective power of the significant differences between groups is considered beneficial, as the reporting of the current experiment's power adds to understanding the strength and limitations of the research and whether adjustments to sample size need to be made for future research designs (Howell, 2013). The power of a test is the probability that a given test will correctly reject a false $H_0$ (Field, 2013; Howell, 2014) when a particular $H_1$ is true (Howell, 2013). Retrospective power (or observed power) is calculated after an experiment has been completed and is based on the experiment's results (Howell, 2013). Retrospective power was calculated as it is in line with the recommendations of Howell (2013, p. 246).

Observed power of the significant results was calculated using SPSS version 25 (Howell, 2013). Cronbach alpha of 95% was selected and the options for observed power was selected under the *Univariate General Linear Model.* SSEIT scores dependent on the sample group (YSCC vs. School) yields a power of 0.539, which means that comparing the total EI score between the two comparison groups will only correctly detect a difference between the sample participants 53.9% of the time. Age-groups yield a reduced power of 0.395 when differentiating between EI scores between groups. Additionally, considering both the age-groups as well as the sample group as the independent variables, the two IV's combined yield an observed power

of 0.731. Lastly, the 5 SSEIT scale items which yielded significant results when comparing EI scores between groups yield a total observed power of 0.977 for correctly differentiating between the two comparative sample groups. For particulars of the observed power breakdown, please refer to Tables 5.3.6.1 -5.3.6.4 in Appendix U.

Given the abovementioned results, it is apparent that differentiating between the two sample groups can be done most accurately by assessing the 5 SSEIT scale items.

### 5.3.7 Summary

To summarise the findings in terms of the analysis and the research questions, there is a significant difference between the two comparative sample groups in terms of the total emotional intelligence score of the 33-items, $t\ (102) = -2.077, p < 0.05$. In terms of emotional intelligence scores, the YSCC sample scores significantly lower ($M = 121.27$) than the school sample ($M = 127.10$). When further comparing the total EI score between samples, results indicate a significant difference present within the 16-year cohort between the two samples, $t\ (20.213) = -2.685, p < 0.05$; where the YSCC 16-year olds score significantly lower ($M = 116.29$) than the school sample 16-year cohort ($M = 131.85$). As such, results indicate that the YSCC sample scores significantly lower in EI, especially within the 16-year cohort.

Mean comparative analysis of the individual test items indicate that the YSCC and School comparative samples significantly differ in 5 of the 33 items (Q3, Q16, Q19, Q23 and Q28_R). The item with the highest effect size (*hedge's* $g = 0.98$) related to the attitude of persisting in the face of challenges, where the entire sample of the YSCC cohort performed significantly lower ($M = 3.38$) than the school sample ($M = 4.44$), $t\ (67.185) = -4.770, p < 0.001$. The second-highest effect size (*Hedges* $g = 0.78$) was noted for Q16, relating to self-presentation and impression on others, where YSCC participants (mostly from 15-17 years) scored significantly lower ($M = 3.67$) than the school participants ($M = 4.44$). As such, when qualitatively comparing the relatively high effect size relating to a persistent attitude in the face of challenges, as well as self-regulation to leave a good impression with the 4 underlying factors of the SSEIT proposed by Schutte et al (2009), the results indicate that the YSCC sample scores significantly low in the underlying factor of managing their own emotions. Additionally, the lowest effect size

(*Hedges g = 0.44*) is recorded for Q19, which relates to awareness or perception of one's own emotions. For Q19, the significance between the two sample groups is confirmed, *t (102) = -2.012; p <0.05;* however, *Figure 5.5* indicates that the observable difference is only present within the 16-year age cohort between the two samples. As such, a relatively large decline in awareness of their emotions is a characteristic viewed in the 16-year YSCC participants. Lastly, Q3 and Q23 both show relatively small effect size of 0.54 (Q3) and 0.59 (Q23), where the YSCC participants score significantly lower for aspects of self-expectation (Q3) and self-motivation (Q23) for the age groups of 15 and 16-year olds. As such, 15-16-year age groups of the YSCC sample seem to struggle more than the school participants of the age cohorts with using emotions to motivate themselves or to regulate their expectations of themselves.

Lastly, the current study indicates a high observed power of 0.977 when comparing the two sample groups based on the abovementioned 5 items, even with the current sample size which otherwise yields a fairly low observed power of 0.54 when differentiating the total SSEIT between the two sample groups. As such, the current data has sufficient statistical power to differentiate on EI levels between the samples, provided the differentiation be done based on the 5 specified items.

### 5.4 The Executive Control Function Tests

Analysis of the executive control function tests was run with a total sample of 42 YSCC participants and 62 School participants. Two of the school participant's ECF data is not added as they have only partially completed the TOL and request to leave participation before taking part in any of the other tests.

Before running the exploratory factor analysis, all the viable data were tested for normality distribution, outliers and homogeneity of variance. All major outliers were removed from each ECF test to ensure assumptions for running a factor analysis are met (Field, 2013). In line with the descriptive nature of the study, findings of each of the ECF tests are compared between the two sample groups using descriptive statistics and graphical illustrations of the mean differences within each age-group between

the two sample groups. The first set of result's descriptive statistics is summarized to describe how the study's cohort responded to each ECF test and to provide a basic description of plausible ECF functions observed within the given test. The initial descriptive statistics are followed by a principal component analysis to determine underlying ECF components present within the current research sample. Thereafter, the final description of ECF differences between groups is discussed to compare differences between the two sample groups descriptively.

### 5.4.1 Tower of London

After running descriptive variables and removing outliers, a total of 39 (92,9%) of the viable YSCC participants and 58 (93,5%) of the viable School participants had data that could be used for further descriptive and comparative results.

*Table 5. 21: Participant Numbers Per Age Group Between Sample Groups Viable for Further TOL Analysis*

| | **14-Year Olds** | **15- Year Olds** | **16-Year Olds** | **17-Year Olds** |
|---|---|---|---|---|
| YSCC Sample Group | 2 | 10 | 15 | 12 |
| School Sample Group | 18 | 11 | 14 | 15 |

*Note: Data Excluded Listwise*

#### *5.4.1.1 Testing Parametric Assumption of Data Variables*

In terms of outliers, participants data for the entire task was marked as missing if they had clicked the "*Next Round"* option 5 or more times (i.e. participants did not participate in problem-solving of 40% of the TOL items or more). Additionally, any extreme outliers for any of the other TOL categories marked as missing for the variable when calculating descriptive mean scores of the categories for more accurate comparisons of the two sample groups' data spread.

The Shapiro-Wilk and Kolmogorov-Smirnov normality distribution tests were referred to for testing of normality distributions of the variable's data for each group separately. Results indicate that the variables which represent the *Total Score, Average % of Solution Time Spent on Planning, Average % of Time spent on Planning When Obtaining a Correct Solution, Average Solution Time for Correct*

*Response, Total Number of Attempts to Complete the TOL* and *Total Number of Extra Attempts* follow normal distribution for the data present in both sample groups, based on results from both the Shapiro-Wilks and the Kolmogorov-Smirnov tests. The variables which provided data on the amount of *Time Taken for Planning* and *Total Solution Time* yielded significant results in the Shapiro-Wilks Test and non-significant results for the Kolmogorov- Smirnov tests. The histograms, skewness and kurtosis for these variables indicated a normal distribution, as such these variables were regarded as normally distributed. Additionally, variables reporting on *Time Taken to Execute the Moves, Extra Moves Used to Complete the Tasks, Number of Resets* and number of times a problem was not attempted (clicked *Next Round*) did not follow normal distribution at all.

All data variables, except for the *Raw Time reported on Planning of Task Execution* in milliseconds, reported non-significant results for Levene's test. As such, almost all the data per sample group follows homogeneity of variance.

#### *5.4.1.2 Descriptive Statistics of TOL Results Between the Two Sample Groups*

The following section reports on the descriptive differences between groups for the TOL variables. The developmental trend of the variables is graphically represented in terms of the mean score of the variable per age-group within the two comparative sample groups. The graphical representations include the results of the YSCC 14-year old group; however, the results of that age-group are considered with caution when comparing between groups as the YSCC sample only contained two participants within the 14-year old age group.

*Table 5. 22: Descriptive Statistics of the Total Score Achieved Between Groups and Age-Group Comparisons*

| | Mean | Std. Deviation | Minimum | Maximum | Range | IQR |
|---|---|---|---|---|---|---|
| YSCC Participants Sample | 29,286 | 3,339 | 21,000 | 35,000 | 14,000 | 4,000 |
| School Participants Sample | 30,000 | 4,018 | 20,000 | 36,000 | 16,000 | 5,000 |
| **14-Year Age Group Descriptives** | | | | | | |
| YSCC Sample | 30,50 | 3,536 | 28 | 33 | 5 | - |
| School Sample | 29.44 | 4.841 | 20 | 36 | 16 | 8 |
| **15-Year Age Group Descriptives** | | | | | | |
| YSCC Sample | 29.11 | 3.689 | 21 | 34 | 13 | 4 |
| School Sample | 29.00 | 3.924 | 20 | 34 | 14 | 5 |
| **16-Year Age Group Descriptives** | | | | | | |
| YSCC Sample | 29.21 | 3.886 | 23 | 35 | 12 | 5 |
| School Sample | 30.00 | 3.843 | 22 | 36 | 14 | 5 |
| **17-Year Age Group Descriptives** | | | | | | |
| YSCC Sample | 29.27 | 2.412 | 26 | 33 | 7 | 5 |
| School Sample | 31.19 | 2.949 | 25 | 35 | 10 | 5 |

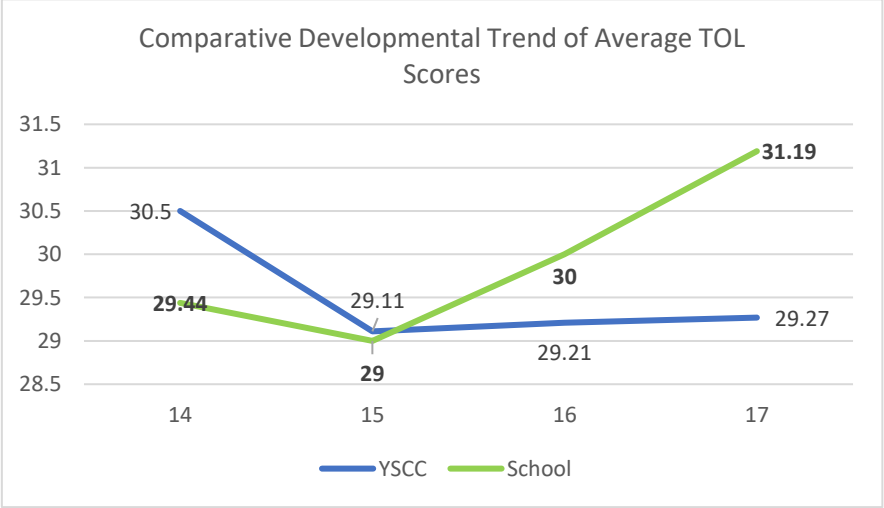



*Figure 5. 9*

The results summarized above indicate that the school sample group generally performs a little better (*M = 30.0)* than the YSCC participants (*M = 29.3)* in the TOL scores. When the general scoring trend is graphically represented according to each age-group per sample, an interesting observation is that the 14 and 15-year school cohort score lower for the total TOL score than the YSCC sample. However, the 14-year age group only comprises of 2 participants, as such the comparison of the age-group is noted

with caution. Additionally, there is only a 0.11 difference between the mean scores of the two samples for the 15-year age-group, as such, the performance of the 15-year cohorts can be viewed as equivalent in performance. A constant increase in average scores is observed in the school sample from the 15-year old age-group till the 17-year old age-group. Comparatively, a slight increase in the average TOL scores is observed for the same age-groups in the YSCC sample data. However, despite the abovementioned differences noted in trends between the two sample groups in TOL responses across age-groups, the statistical differences indicate that the difference between the two sample scores is no more than half a standard deviation, as such not much difference lies between the two sample scores per age-group. Given the abovementioned observation, the illustrated graphical difference between the performance of the two samples needs to be viewed with the statistical information in mind. Given that only 2 participants comprise of the YSCC 14-year old sample group, the scores for the age-group are not considered for further comparison.

*Table 5.23.* (below) is provided as a summary for the average time in milliseconds each sample group took to plan, execute and complete the entire TOL task (after removal of all outliers). The descriptive results indicate that on average, the YSCC took longer than the School sample to complete the entire TOL task as well as to execute moves to solve the problem; however, the YSCC sample on average took 2 seconds less time for planning prior to the execution of the moves. The measure of the dispersion of results indicate somewhat similar standard deviations and IQR for the *Total Time for Execution* and *Average Execution Time*, but a larger difference in the dispersion of results is seen for the *Average Planning Time* within the school sample. As such, it is observed that the time taken to plan is not only more within the sample, but there is a greater variance in participant's planning times for the school sample.

*Table 5. 23: Descriptive Statistics of the Time Taken by the Two Sample Groups to Plan, Execute and Complete the TOL Tasks*

| | Mean | Std. Deviation | Minimum | Maximum | Range | IQR |
|---|---|---|---|---|---|---|
| Total Time for TOL in ms. | | | | | | |
| YSCC | 610754.31 | 181180.018 | 345849 | 110451 | 758670 | 193204 |
| School | 585435.42 | 197301.621 | 199929 | 1180833 | 980904 | 239449 |
| Average Planning Time in ms. | | | | | | |
| YSCC | **11564.899** | **3131.384** | **6066.786** | **18940.455** | **12873.669** | **3498.191** |
| School | **13472.117** | **6025.676** | **4591.600** | **31809.917** | **27218.317** | **8381.884** |
| Average Execution Time in ms. | | | | | | |
| YSCC | 14185.170 | 6091.484 | 4617.167 | 27180.267 | 22563.100 | 6636.267 |
| School | 12574.375 | 5415.102 | 4882.933 | 27251.600 | 22368.667 | 6983.491 |

*Figures 5.10* and *5.11* (below) graphically represent the average time each age-group within the two samples used to execute the problem-solving task and time used for planning. Looking at the graphical representation, a notable observation from the findings is that participants in the 17-year old age-group, on average, take the same time to execute a solution for the TOL tasks; however, *Figure 5.11* indicates the largest difference within the 17-year old age group between the samples for time spent on planning prior to the execution of the TOL tasks. When comparing the difference in total TOL scores (*Figure 5.9)* with the time spent on planning and execution, an apparent difference is observed in the two sample groups for the age of 17; where the school sample (which took longer in time for planning than the YSCC sample) score better in the total TOL score for problem-solving.

An additional observation in *Figure 5.10* is that in both sample groups data, the 16-year-old age group took the least time to execute the TOL tasks, which can lead to speculation on improved processing speed or less planning while executing. An alternative observation of the cause of low execution time is based on *Figure 5.15*, where the YSCC 16-year cohort clicked next round more often than the other age-group cohorts (*M = 0,87)*. Comparing the average planning time *(Figure 5.11)* and total TOL score *(Figure 5.9)* of the 16-year old age-group of the two samples, findings indicate that planning time

plateaus for the school sample and drops notably in the YSCC sample, while the Total TOL score increases from the 15-year old age group.

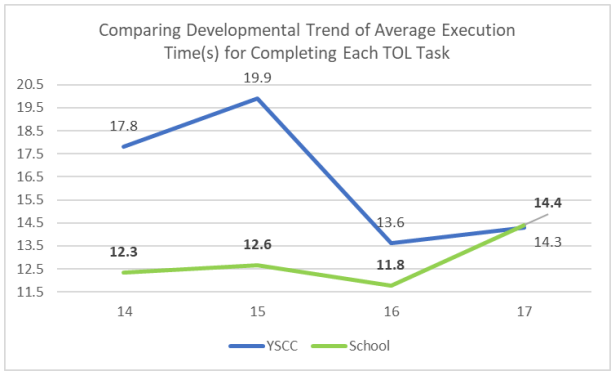



*Figure 5. 10*

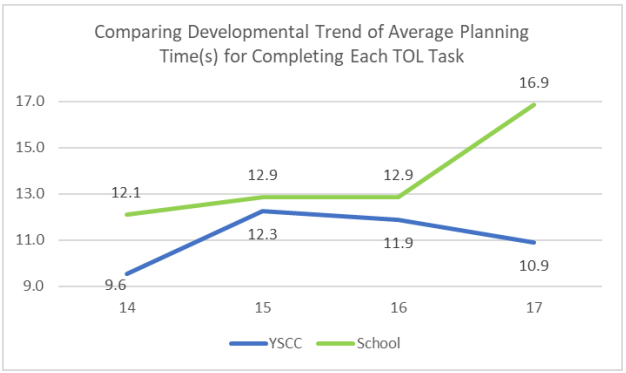



*Figure 5. 11*

Observations of the 15-year age group indicate that YSCC participants on average score higher for the TOL than the school group, despite their lower planning time. However, the 15-year old age group for the YSCC sample do take a notably longer time to execute the problem-solving task, which can indicate that unlike the school participants, the YSCC participants may be using the ECF of working memory to plan and execute possible solutions. The consideration of possible working memory during the execution of problem-solving tasks is supported by the observation in *Figure 5.16*, where the 15-year old age-group of YSCC participants use considerably more extra moves than any other age-group to complete the TOL task (*M = 10,444).*

*Table 5. 24: Descriptive Statistics Comparing the Time Generally Spent on Planning and the Time Spent on Planning which leads to Correct Results*

| | Mean | Std. Deviation | Minimum | Maximum | Range | IQR |
|---|---|---|---|---|---|---|
| Average Planning Time for Correct Response in ms. | | | | | | |
| YSCC | 10459165.17 | 4954630 | 77328.000 | 19574923.00 | 19497595.00 | 5322513.00 |
| School | 133444.982 | 63006.301 | 45818.00 | 318099.00 | 272281.00 | 86638.00 |
| Average Execution Time for Correct Response in ms. | | | | | | |
| YSCC | 187975027.0 | 1046404549 | 4308.0 | 6201615385 | 6201611077 | 7113250.00 |
| School | 432581565,873 | 1633959602,849 | 7817,000 | 8523833333 | 8523825516 | 57788.00 |

As the planning and execution times did not meet the assumptions of normality and homogeneity of variance, the abovementioned comparisons are provided as a summary of observations. To track the developmental trends of the comparative groups, the *Percentage of Time used for Planning* from the *Entire Solution Time of the Task* is calculated and graphically summarized below.

Findings from *Table 5.25* (below), as well as from *Figures 5.12 – 5.13* (below), indicate that the proportion of time spent on planning by the YSCC participants follows a steep increase in trajectory till the age-group of 16 (who allocate almost half of their solution time on planning), before a decline starts towards the 17-year age group in proportion of time spent on planning. Comparatively, the School participants' average proportion of planning time (generally and for a correct solution) is longer than YSCC participants but follows a less steep trajectory in improved planning times continuously.

*Table 5. 25: Descriptive statistics comparing the percent of time spent on planning generally and the percent of time spent on planning that leads to correct solutions*

| | Mean | Std. Deviation | Minimum | Maximum | Range | IQR |
|---|---|---|---|---|---|---|
| % of Total Time Spent on Planning | | | | | | |
| YSCC | 0,463 | 0,100 | 0,300 | 0,726 | 0,426 | 0,115 |
| School | 0,512 | 0,112 | 0,309 | 0,741 | 0,432 | 0,159 |
| % of Total Planning Time for Correct Response | | | | | | |
| YSCC | 0,510 | 0,103 | 0,328 | 0,761 | 0,433 | 0,118 |
| School | 0,555 | 0,106 | 0,346 | 0,765 | 0,420 | 0,137 |

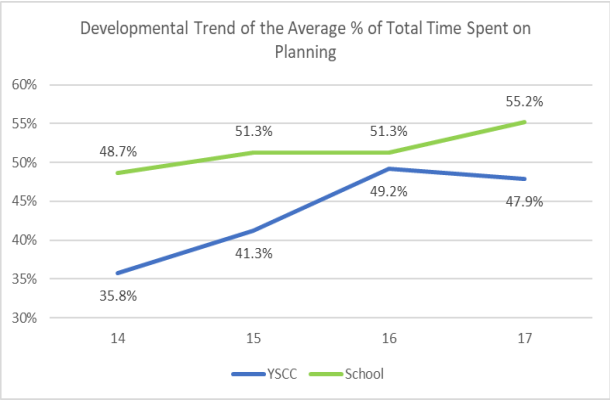



*Figure 5. 12*

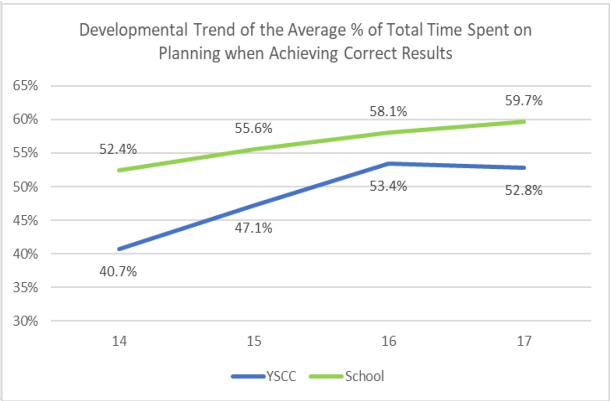



*Figure 5. 13*

*Table 5. 26: Descriptive Summary of Problem-Solving Behaviour Strategies Employed Between the Two Sample-Groups*

| | Mean | Std. Deviation | Minimum | Maximum | Range | IQR |
|---|---|---|---|---|---|---|
| Total Extra Attempts to Complete TOL | | | | | | |
| YSCC | 4,143 | 2,017 | 1 | 9 | 8 | 3 |
| School | 4,400 | 2,454 | 0 | 10 | 10 | 4 |
| Average No. of Extra Moves Made to Complete TOL | | | | | | |
| YSCC | 6,829 | 7,217 | 0 | 31 | 31 | 9 |
| School | 6,164 | 7,280 | 0 | 29 | 29 | 10 |
| Average No. of Resets Complete TOL | | | | | | |
| YSCC | 2,429 | 2,266 | 0 | 8 | 8 | 4 |
| School | 2,964 | 2,631 | 0 | 9 | 9 | 4 |
| Average No. of Next Rounds while Completing TOL | | | | | | |
| YSCC | 0,829 | 1,224 | 0 | 4 | 4 | 2 |
| School | 0,509 | 0,920 | 0 | 3 | 3 | 1 |

The number of extra attempts used to complete the TOL, coupled with the average number of times a task was reset to a new attempt, as well as the average number of extra moves that were used to complete the task, are descriptively illustrated and discussed as an indication of the level of planning and its implementation for solving the TOL tasks within each age group. The number of extra attempts is observed as an indication of whether the participants planning ability improved with age as well as the comparison between the two sample groups. The number of extra attempts is dependent on two behavioural actions; the first is clicking the reset button and the second is solving the problem using extra moves than required. The number of resets can be viewed as an indication of a participant being aware of an error made during their problem solving and reset the task to try a new attempt. The number of extra moves can either be an indication of impulsively attempting to complete the task, or it can indicate a lack of planning before the execution of the task. Additionally, the option of clicking *"Next"* is an indication of a participant not wanting to complete the task or wanting to skip the task, which can speak to impulsivity or lack of persistence when facing a difficult problem-solving task.

*Table 5.26.* (above) summarized the descriptive statistics of general differences between the two sample groups. The results summarized indicate that on average, the YSCC participants use more extra moves (*M = 6,829)* and click next round more often (*M = 0,829*) than school participants (*M = 6,164;*

*M = 0.509)*. As such, there is an indication of possible impulsivity when attending to a problem-solving task. Comparatively, the school sample group, on average, required more attempts to complete the TOL task (*M = 4,4),* which is likely contributed to by the comparatively higher number of times the school participants opted to reset the task (*M = 2,964*) than the YSCC sample participants (*M = 4,143; M = 2,429)*. In summary, the observations summarized in *Table 5.26.* above indicate that the school participants possibly were slightly more aware of their errors and due to this ended up resetting more often, which increased the number of attempts used to complete the task. Comparatively, the YSCC participants on average use more moves to complete the task and are also more prone to skipping attempting to solve a problem, which relates to the lower average of extra attempts between the two sample groups.

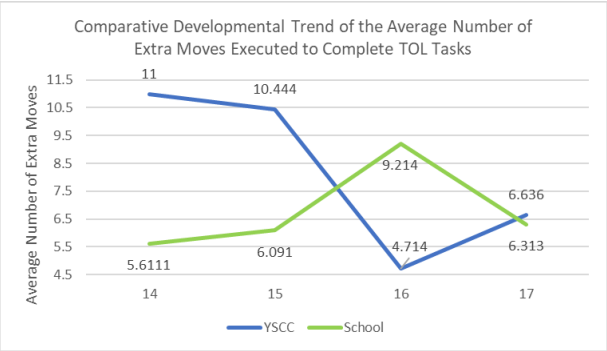



*Figure 5. 14*

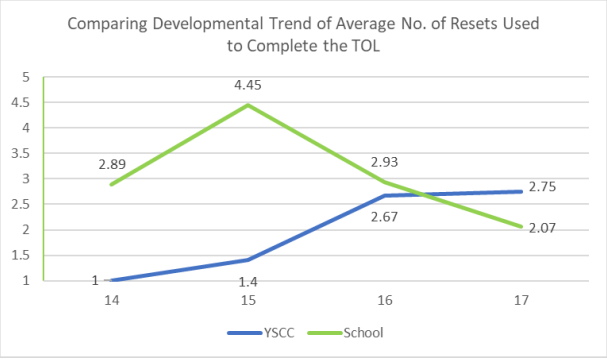



*Figure 5. 15*

*Figures 5.14 – 5.17* provide descriptive illustrations of average scores of each age-group between the two samples. The observable difference is noted for the 16-year old age group in terms of extra moves used and the number of times a problem attempt was skipped (i.e. clicked next), where the 16-year old group for the YSCC has the lowest average of extra moves used between the samples and a relatively high average of the number of times "*Next"* was clicked, indicating a possible higher level of impulsivity in the age group.

An additional observation is relating to the 15-year old age-group is that the school cohort yields relatively low extra moves and the lowest number of "*Next Round"* option and a relatively high score for the average number of resets. As such, the 15-year school cohort is more aware of their error while problem-solving and tends to rectify the error by setting reset three times more often (*M = 4.45)* than the YSCC 15-year cohort (*M = 1.4).*

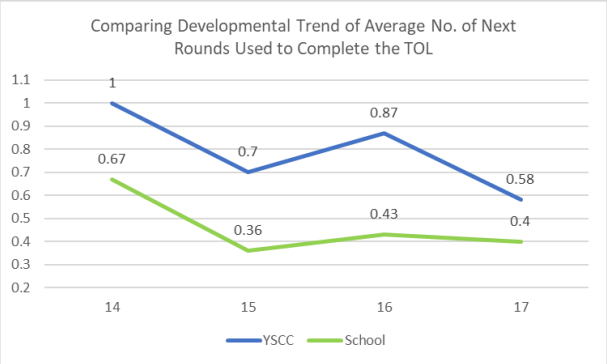



*Figure 5. 16*

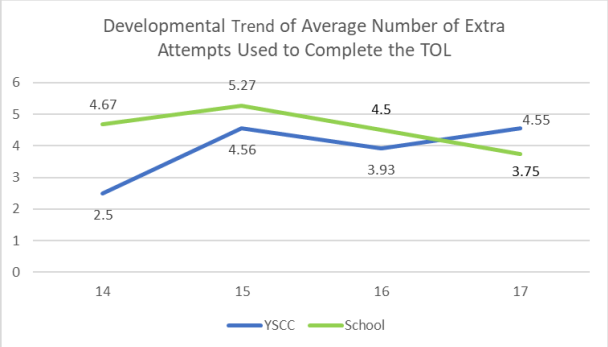



*Figure 5. 17*

### *5.4.1.3 Summary.*

Firstly, a general trend is noted between the 17-year cohort of the two sample groups, where the school sample cohort tends to perform better ($M_{TOLTotal}$ *= 31.19)* than the YSCC sample ($M_{TOLTotal}$ *= 39.27)* with a lower average for extra moves, resets or skipping the problem altogether (i.e. clicking *Next Round*).

Secondly, a general observation is that the school sample cohort yields a higher average score for the *Total TOL Score*, *Proportion of Time spent on Planning* (both generally and when achieving correct results), *Execution time when achieving correct results*, *Number of Extra Attempts* and *Number of Resets*. As such, findings indicate a general ability in school participants to plan, execute the plan as well as pick up on their errors and attempt to rectify their errors. Comparatively, the YSCC sample only scores a higher mean score for *Total Time Taken to complete the TOL*, *The Number of Extra Moves* and *Average Times 'Next Round' was Selected.* As such, findings indicate a possible susceptibility to impulsivity in the YSCC sample and a lower indication of pre-planning. More specifically, findings indicate the 16-year YSCC cohort to be at relatively high risk of possible impulsivity and lack of pre-planning to problem-solving.

### 5.4.2 Stroop Colour-Word Test

A total sample of 40 YSCC participants and 62 School participants had completed the computer-based Stroop colour-word test. After removal of outliers, only 23 (57.5%) YSCC and 45 (72.5%) school participants were viable for further analysis.

*Table 5. 27: Participant Numbers Per Age Group Between Sample Groups Viable for Further Stroop Analysis*

| | 14-Year Olds | 15- Year Olds | 16-Year Olds | 17-Year Olds |
|---|---|---|---|---|
| YSCC Sample Group | 2 | 6 | 4 | 11 |
| School Sample Group | 10 | 8 | 13 | 14 |

#### *5.4.2.1 Testing Parametric Assumptions of Data Variables*

Any extreme data responses that were indicated as extreme outliers in descriptive boxplots were removed from the data-set (the specific result for that variable only).

No participants indicated extreme outliers for the variables *Proportion of Incongruent Stimulus Correct*. Variables relating to the average time difference in the Stroop test (*Mean RT correct congruent / Mean RT correct control; Script elapsed time; Mean RT correct incongruent / Mean RT correct control; and Difference in Average Incongruent-Congruent responses*) follow normality distribution and meet the assumption of homogeneity. Comparatively, all variables relating to the proportion of correct scores (*Total, Congruent, Incongruent and Control),* do not follow normality distribution nor do they meet assumptions for homogeneity, except for the variable *Proportion of Incongruent Correct*.

#### *5.4.2.2 Descriptive Statistics of the Stroop Colour-Word Results*

*Table 5. 28: Descriptive Statistics Comparing Proportion of Correct Stroop Responses for Congruent, Incongruent and Control Stimulus*

| Group | Mean | Std Deviation | Minimum | Maximum | Range | IQR |
|---|---|---|---|---|---|---|
| % of Total Proportion Correct | | | | | | |
| YSCC | 0,888 | 0,080 | 0,690 | 0,988 | 0,298 | 0,095 |

| | | | | | | |
|---|---|---|---|---|---|---|
| School | 0,924 | 0,045 | 0,810 | 0,988 | 0,179 | 0,071 |
| % of Total Proportion Correct of Congruent Trials | | | | | | |
| YSCC | 0,947 | 0,062 | 0,750 | 1,000 | 0,250 | 0,071 |
| School | 0,978 | 0,027 | 0,893 | 1,000 | 0,107 | 0,036 |
| % of Total Proportion Correct of Incongruent Trials incongruent | | | | | | |
| YSCC | 0,784 | 0,180 | 0,357 | 1,000 | 0,643 | 0,286 |
| School | 0,840 | 0,123 | 0,536 | 1,000 | 0,464 | 0,250 |
| % of Total Proportion Correct of Control Trials | | | | | | |
| YSCC | 0,933 | 0,056 | 0,821 | 1,000 | 0,179 | 0,107 |
| School | 0,953 | 0,042 | 0,857 | 1,000 | 0,143 | 0,071 |

*Data Extracted Listwise*

Looking at the proportion of correct responses, the general trend observed is that YSCC yields less correct results than the school sample, by a small margin of difference between the scores. The most descriptively observable difference is in the correct results yielded for the incongruent stimulus, where the minimum score for the YSCC is 35.7%, compared to the minimum of 53.6% correct incongruent

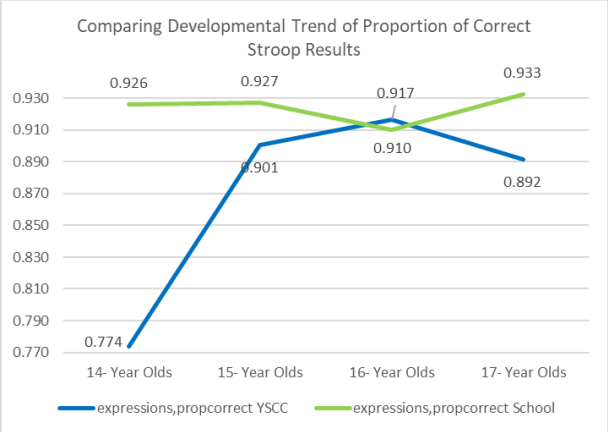



*Figure 5. 18*

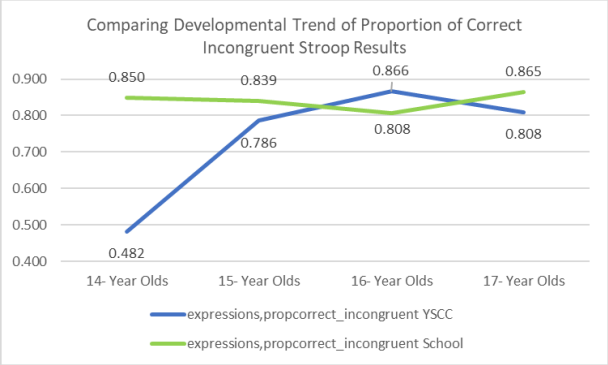



*Figure 5. 19*

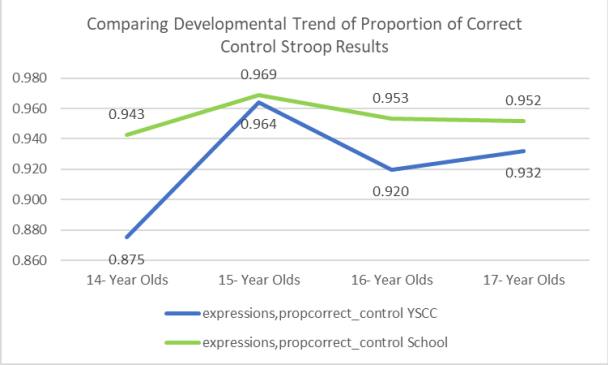



*Figure 5. 20*

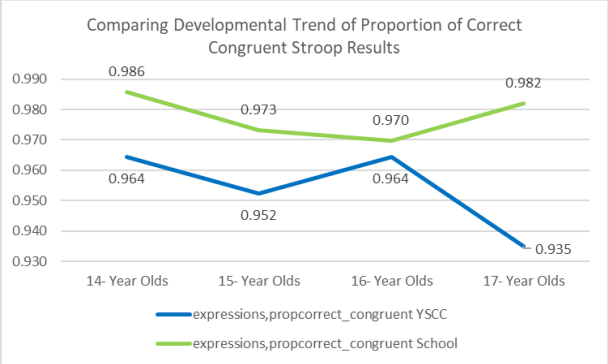



*Figure 5. 21*

results scored by the school sample. As such, there is a greater range between the two sample groups in the variable of the *proportion of correct incongruent stimulus*.

Figures 5.18 -5.21 provide descriptive illustrations of the scoring trajectory along the age-groups. Looking at the total correct and the proportion of incongruent results that are correct, the graphs indicate similar developmental trajectories where all YSCC age-group achieve fewer correct results on average than the school participants, except for the 16-year cohort. The YSCC 16-year cohort indicates the highest level of performance in the correct incongruent responses (these are responses in which the participant needs to respond for the colour they see and not the word that is written), compared to the 16-year old school participants, who performed scored less.

Additionally, the YSCC 16-year cohort also indicates an aptitude to respond to the congruent stimulus better than the control stimulus (a block of colour), whereas the other YSCC age-groups (not considering the 14-year cohort) perform

better in the control stimulus than the congruent and incongruent.

Summarizing the results viewed in the graphs, the trend of the total correct score indicates a similar trajectory with the incongruent correct score trend. However, the 16-year YSCC cohort seems to respond differently when comparing their results to the other age-groups, as it is the only cohort which performs better when responding to a stimulus involving letters and colours (i.e. distracting stimulus), than the basic control stimulus.

Following guidelines from previous Stroop studies (Khng & Lee, 2014; Tiego et al., 2018), interference effects of the Stroop were measured by the difference in latency or accuracy between the incongruent and control and the congruent and control to assess inhibitory ability or efficiency (Khng & Lee, 2014). Interference effects between groups were calculated as the difference between the average MRT scores for congruent and incongruent trials (i.e. subtracting mean reaction time (MRT) trials in the congruent condition/MRT trials in the control from MRT on incongruent trials/MRT trials in control) (Tiego et al., 2018). To gain an understanding of the developmental trend of the MRT between groups, as well as an indication of the average time taken to respond to the interference effect (see *Figure 5.2.2.7).*, *Table 5.29* below summarises the descriptive differences between groups.

*Table 5. 29: Descriptive Statistics of the Average Response Times for the Stroop Stimulus Between the Two Sample Groups*

| Group | Mean | Std Deviation | Minimum | Maximum | Range | IQR |
|---|---|---|---|---|---|---|
| Total Script Time | | | | | | |
| YSCC | 313952,565 | 98847,076 | 151826 | 509632 | 357806 | 136778 |
| School | 298269,778 | 76436,654 | 170601 | 549231 | 378630 | 108926 |
| Total Mean Response Time (MRT) | | | | | | |
| YSCC | 2350,905 | 949,047 | 1091,514 | 4208,493 | 3116,979 | 1476,308 |
| School | 2109,900 | 599,979 | 1115,468 | 3426,423 | 2310,954 | 965,899 |
| MRT of Correct Congruent Responses | | | | | | |
| YSCC | 2187,822 | 920,414 | 1033,750 | 4432,370 | 3398,620 | 1475,567 |
| School | 2029,074 | 588,787 | 1087,741 | 3345,000 | 2257,259 | 934,795 |
| MRT of Correct Incongruent Responses | | | | | | |
| YSCC | 2470,137 | 934,353 | 1035,429 | 4654,864 | 3619,435 | 1330,087 |
| School | 2096,711 | 564,961 | 1240,593 | 3496,115 | 2255,523 | 912,035 |

| | | | | | | |
|---|---|---|---|---|---|---|
| MRT of Correct Control Responses | | | | | | |
| YSCC | 2406,507 | 1141,578 | 1082,036 | 5293,542 | 4211,506 | 1778,769 |
| School | 2196,897 | 806,209 | 1010,280 | 4439,036 | 3428,756 | 1022,405 |
| Mean RT correct congruent / Mean RT correct control. | | | | | | |
| YSCC | 0,941 | 0,163 | 0,708 | 1,338 | 0,630 | 0,236 |
| School | 0,961 | 0,205 | 0,658 | 1,469 | 0,812 | 0,271 |
| Mean RT correct incongruent / Mean RT correct control | | | | | | |
| YSCC | 1,086 | 0,238 | 0,650 | 1,548 | 0,899 | 0,397 |
| School | 0,998 | 0,200 | 0,608 | 1,453 | 0,845 | 0,328 |
| Difference in Average RT of Incongruent-Congruent responses | | | | | | |
| YSCC | 0.145 | 0.164 | -0.157 | 0.391 | 0.548 | 0.290 |
| School | 0.037 | 0.194 | -0.464 | 0.393 | 0.857 | 0.251 |

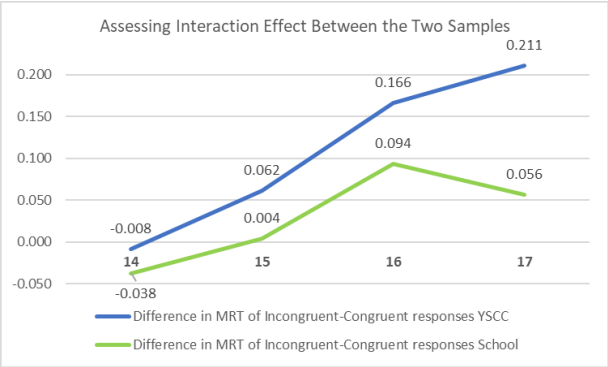



*Figure 5. 22*

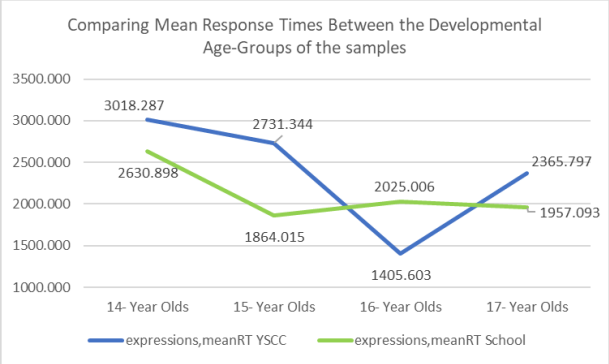



*Figure 5.23*

Using Table 5.29. above as a reference for descriptive results, interference effects were calculated by the variable "*Difference in Average MRT of Incongruent and Congruent Responses"*. As such, the YSCC sample has a greater difference between their congruent and incongruent MRT (*M = 0.145)* than the school sample (*M = 0.037)*. To further assess the difference in interference effects, the Figures below break down the MRT according to incongruent and congruent stimulus.

Figures 5.22 – 5.25 provide illustrative descriptions of the mean response time across the age groups between the two sample groups. The YSCC 16-year cohort yields observably different results as the 16-year cohort on average take longer to respond to both congruent and incongruent than they control stimulus. However, an interesting observation in the YSCC sample is that the

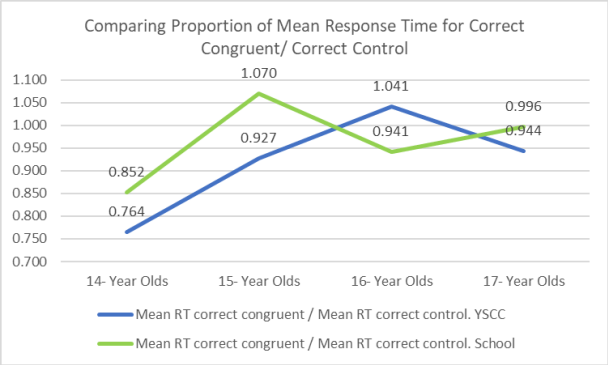



*Figure 5. 24*

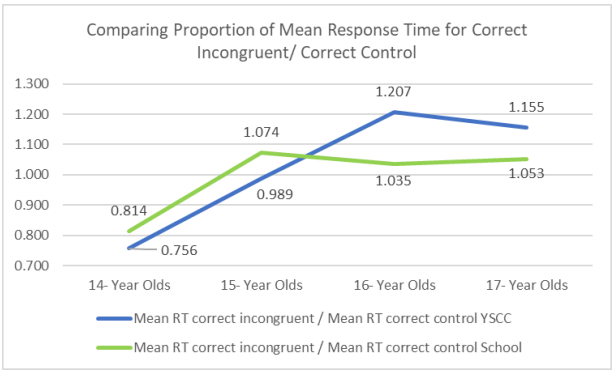



*Figure 5.25*

interference effect is higher in the 16-year and 17-year cohort than within the school sample. As such, the 16 and 17-year-old YSCC participants require longer to respond to interfering stimulus than the school samples.

When coupling the MRT results with the proportion of incongruent results correct, it is observable that the 16-year cohort takes more time to respond to interfering stimulus than any also achieve the highest number of correct results. As such, the 16-year olds indicate an ability of attentional inhibition in their responses as they are able to control their attention in the face of distracting stimuli (Tiego et al., 2018), and not just responding to the presented stimulus automatically.

### 5.4.3 Wisconsin Card Sorting Test Results

Post removal of extreme outliers, a total of 27 (64,3%) of the viable YSCC participants (*N = 42)* and 41 (66,1%) of the viable School participants (*N = 62)* had data that could be used for further descriptive and comparative analysis of results. *Table 5.30* (below) summarizes the demographic breakdown of the age-cohorts between the two sample groups, who fell within the IQR of the WSCT testing variables. As only 1 participant from the YSCC 14-year cohort is viable, the participant's results are not considered for between-group comparisons.

*Table 5. 30: Participant Numbers Per Age Group Between Sample Groups Viable for Further WCST Analysis*

| | **14-Year Olds** | **15- Year Olds** | **16-Year Olds** | **17-Year Olds** |
|---|---|---|---|---|
| YSCC Sample Group | 1 | 6 | 12 | 8 |

| | | | | |
|---|---|---|---|---|
| School Sample Group | 17 | 5 | 11 | 8 |

*Note: Data Excluded Listwise*

#### *5.4.3.1 Testing Parametric Assumptions of Data Variables*

In terms of outliers, all data for participants who (1) scored extreme outliers for the response type (i.e. selected only one rule from colour, form or number for more than 110 trials), (2) scored extreme outliers for perseverative error, (3) scored extremely low outliers for % of conceptual response, (4) scored extreme outliers for the number of trials taken to successfully complete the first category, and (5) yielded a score of 60 or less total trials taken to complete the WSCT task. The case removals of extreme outliers based on lack of set-shifting *(N=19)* and high perseverative error (*N = 9)* is based on findings from studies indicating that these testing variables are sensitive to frontal lobe damage in the WCST (Gläscher, Adolphs & Tranel, 2019; Nagahama, 2005). Cases were removed for being an extreme outlier for low conceptual responses (*N = 2)* and the number of trials executed before the completion of the first category (*N = 5)*, based on previous research findings confirming that low levels of conceptual responses and high levels of trials executed to complete the first category are an indication of improper frontal lobe functioning (Coulacoglou & Saklofske, 2017; Singh et al., 2017).

The variables relating to the time, the conceptualisation of rules, ability for shifting set and the average change in conceptual efficiency (*WCST script time, Response for the Rule of Number, Total Correct, Total Error, Conceptual Response, Perseverative Error and Response, and Learning to Learn)* follow normality distribution and the assumption of homogeneity of variance between the two sample groups. Additionally, the variables relating to possible distractibility and grasping of the abstract concept (i.e. the *Rule of Colour, Failure to Maintain Set, Completed Categories, Total Trials out of 128 cards)* do not follow a normality distribution but do indicate homogeneity of variance between the two sample groups. Findings indicate that only the variables of *the Rule of Form,* and *Number of Trials Executed to Complete the First Category* do not meet the abovementioned parametric assumptions.

#### *5.4.3.2 Descriptive Statistics of the WCST Variables*

Following the descriptive design of the study, *Table 5.31* (below) summarizes the descriptive statistics of all WSCT variables for between-group comparisons. The summarized results indicate that on average, the school participants took longer to execute the WCST, but also performed better in terms of correct responses and conceptualisation of the rules. The higher ability in school participants to conceptualise is reflected in a lower mean score of the variable *trials needed to complete the first category* than the YSCC sample, as well as a higher mean score of the school sample for the variable *completing more categories*. An interesting observation, however, is that the school sample scores lower for the variable of *Learning to Learn*, which reflects the participant's average change in conceptual efficiency across the consecutive categories of the WCST. Further analysis of the descriptive results indicates that the school sample scores higher for perseverative responses and perseverative error, which also increases their chances of failing to maintain set. As such, descriptive comparisons of results between groups indicate that the school sample has an increased ability for conceptual thought and processing than YSCC sample, however, the YSCC sample indicates an increased maturation in the ability to change in conceptual efficiency and higher cognitive flexibility than the school sample.

*Table 5. 31: Descriptive Statistics of All WSCT Testing Variables*

| Sample | Mean | Std. Deviation | Minimum | Maximum | Range | IQR |
|---|---|---|---|---|---|---|
| WSCT Total Script Time | | | | | | |
| YSCC | 440225,22 | 114484,44 | 185234 | 703870 | 518636 | 128386 |
| School | 457273,44 | 112325,92 | 236352 | 712643 | 476291 | 111846 |
| % Colour (Trial Response) | | | | | | |
| YSCC | 31,385 | 12,807 | 9,4 | 59,4 | 50,0 | 18,7 |
| School | 27,110 | 12,453 | 8,6 | 64,1 | 55,5 | 15,3 |
| % Form (Trial Response) | | | | | | |
| YSCC | 38,719 | 25,448 | 9,4 | 84,4 | 75,0 | 49,3 |
| School | 32,585 | 17,740 | 8,6 | 71,1 | 62,5 | 26,9 |
| % Number (Trial Response) | | | | | | |
| YSCC | **29,896** | 23,984 | 0,0 | 80,5 | 80,5 | 45,3 |
| School | **40,307** | 20,645 | 0,0 | 82,0 | 82,0 | 35,2 |
| No of Total Trials | | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| YSCC | 127,19 | 3,52 | **110,0** | 128 | 18 | 0,0 |
| School | 126,73 | 6,273 | 90,0 | 128 | 38 | 0,0 |
| % Total Correct | | | | | | |
| YSCC | 50,285 | 11,896 | 28,1 | 71,8 | 43,7 | 16,4 |
| School | 56,188 | 9,808 | 38,3 | 75,8 | 37,5 | 17,2 |
| % Conceptual Response | | | | | | |
| YSCC | 34,966 | 15,170 | 7,8 | 68.2 | 60,4 | 18,0 |
| School | 42,022 | 12,823 | 20,3 | 68,0 | 47,7 | 22,25 |
| % Conceptual Response from Total Correct Responses | | | | | | |
| YSCC | 0,663 | 0.160 | 0,3 | 0,9 | 0,6 | 0,2 |
| School | 0,729 | 0,110 | 0,5 | 1,0 | 0,5 | 0,15 |
| % of Preservative Error | | | | | | |
| YSCC | 10,122 | 6,118 | 0,0 | 22,9 | 22,9 | 8,1 |
| School | 13,802 | 7,143 | 2,5 | 29,2 | 26,6 | 10,1 |
| % of Perseverative Responses | | | | | | |
| YSCC | 6,264 | 3,572 | 0,0 | 12,5 | 12,5 | 4,7 |
| School | 7,654 | 4,047 | 1,6 | 20,3 | 18,8 | 6,0 |
| (Values) Sum Failure to Maintain Set | | | | | | |
| YSCC | 1,22 | 1,340 | 0,0 | 4,0 | 4,0 | 2,0 |
| School | 1,51 | 1,344 | 0,0 | 4,0 | 4,0 | 3,0 |
| Values of No. of Completed Categories | | | | | | |
| YSCC | 2,7 | 1,463 | 1,0 | 6,0 | 5,0 | 3,0 |
| School | 3,37 | 1,157 | 1,0 | 6,0 | 5,0 | 1,0 |
| No. of Trials to Complete First Category | | | | | | |
| YSCC | 25,52 | 16,435 | 10,0 | 67,0 | 57,0 | 2,0 |
| School | 16,54 | 6,731 | 10,0 | 38,0 | 28,0 | 9,0 |
| Learning To Learn | | | | | | |
| YSCC | -11,507 | 9,997 | -28,1 | 11,2 | 39,3 | 16,4 |
| School | -13,054 | 10,287 | -33,6 | 1,7 | 35,6 | 18,6 |

*Note: Descriptive Statistics Excluded Listwise*

Following the descriptive summary provided in *Table 5.31* (above), a difference between groups is noticed for the conceptualisation of the WCST rules. Results indicate that the YSCC sample on average processes the rules of colour and form more than the school sample. Comparatively, the school sample indicates an aptitude for processing the rule of number more often than the YSCC sample. However, when viewing the developmental trend of rule processing across the age-groups, *Figures 5.4.3.2.1-*

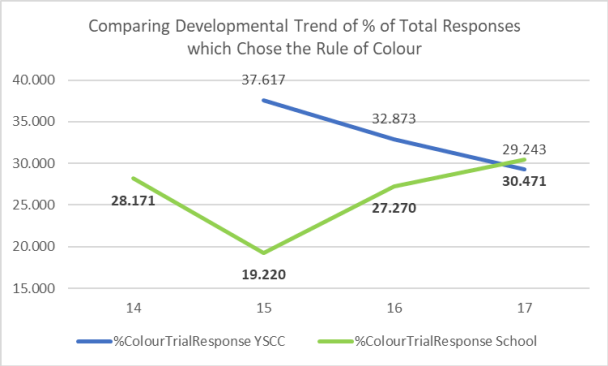



*Figure 5.26*

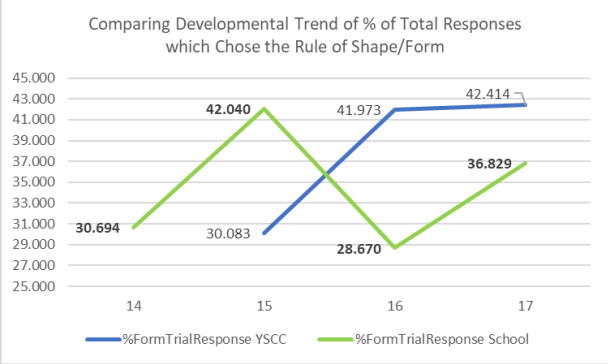



*Figure 5.27*

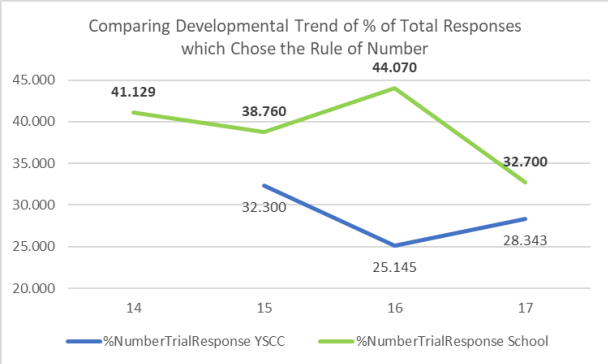



*Figure 5.28*

*5.4.3.2.3* illustrate that participants from the two samples follow different developmental trends in rule recognition (colour, form, number).

To summarize *Figures 5.26--5.28,* the age group of 14-years (school sample) indicate a slightly more increased recognition of the rule of number (*M = 41.13%)* than the other rules.

Comparing the age-related trend of the rules of colour and form, the graphs verify that the YSCC participants on average recognize the rule of colour and form than the school participants. However, differences are noted more clearly when comparing the developmental trend of responding to the rules.

The developmental trend indicates that the 15-year cohort between the two samples have contrasting levels of rule recognition for colour and form, where YSCC 15-years score high for colour and low for form, compared to the school 15-year cohort who score high for form and low for colour. Similar contrasting scores are also noted for the 16-year cohorts between groups in the rules of form and number. Details pertaining to the differences can be viewed in *Figures 5.26 – 5.28.*

Descriptions of the development of rule recognition indicate that the YSCC participants develop the recognition of colour (15-years) and then move on to the recognition of form (16-years), but keep increasing for their recognition of the rule of form. Comparatively, the school sample indicates a development or preference to the rule of form (15-years), which then shifts preference to the rule of

number (16-years) and then develops a better recognition of colour (17-years) than the previous age-groups had.

The WCST results were interpreted by dividing the results format into two categories in terms of conceptual level response and perseverative error (as illustrated by *Figures 5.29 – 5.35*). The first set of results indicate a similar trend within and between groups relating to the total proportion of correct WCST responses. *Figures 5.29 – 5.31* verify that both samples follow a similar pattern of conceptual response to the total score of correct responses. However, when the percentage of conceptual response is calculated from the total correct responses, *Figure 5.31* indicates that along the age developmental curve, school participants keep a relatively stable level of conceptual response, whereas the YSCC participants' conceptual level response seems to gradually decline (despite a relatively high level of correct responses). As such, results indicate that 37% of the YSCC 17-year cohort's correct responses are a result of a random response, which could have been a result of impulsively clicking on the cards.

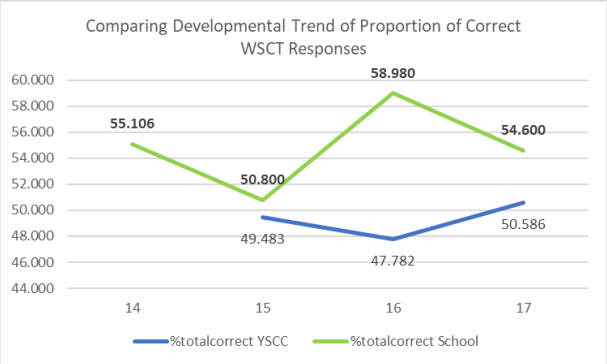



*Figure 5.29*

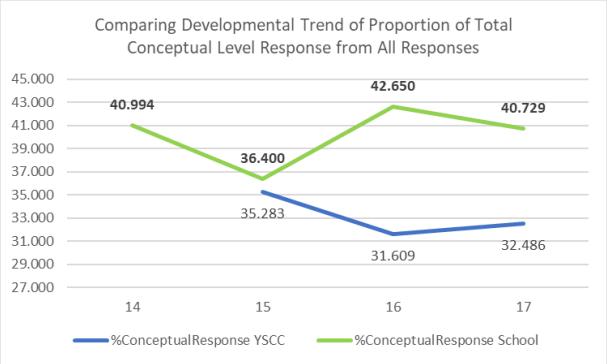



*Figure 5.30*

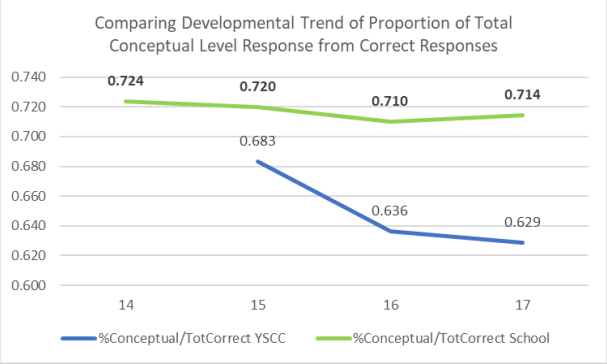



*Figure 5.31*

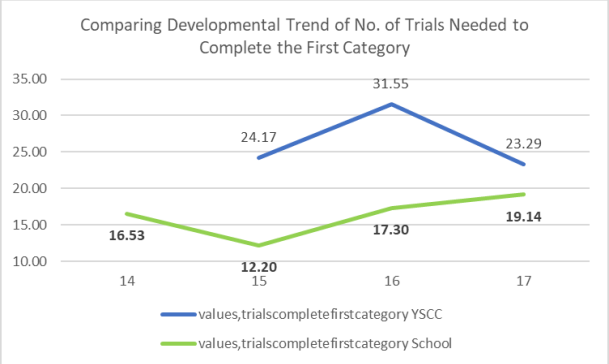



*Figure 5.32*

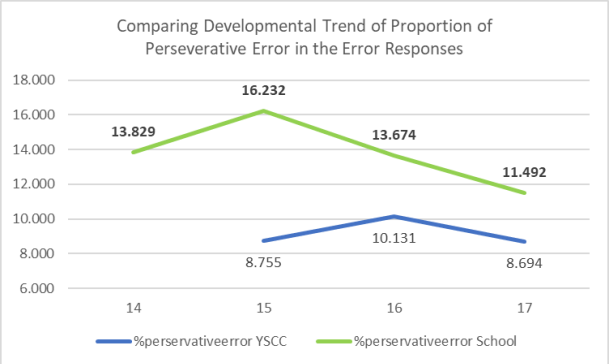



*Figure 5.33*

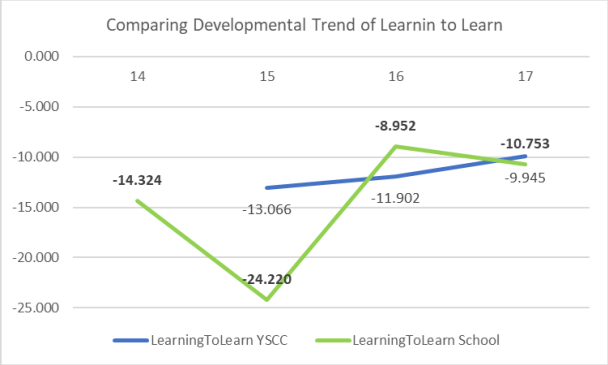



*Figure 5.34*

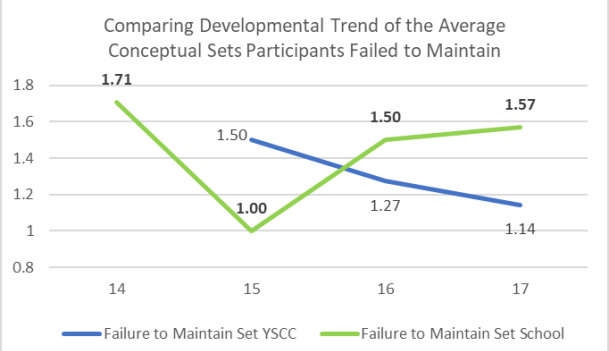



*Figure 5.35*

The graph comparing the number of responses it took prior to the completion of the first category (*Figure 5.32*), seems to be inversely related to conceptual response (when comparing descriptive results). As expected, the YSCC participants require relatively more trials than school participants. However, the abovementioned implication of impulsively selecting cards needs to also be considered for the high level of trials, which can only be confirmed post an exploratory factor analysis.

The second category of results speaks to perseverative error (i.e. cognitive inflexibility). As confirmed in *Table 5.31* (above), the YSCC sample reports relatively low perseverative error compared to the school sample. Additionally, YSCC participants indicate a linear gradual increase in Learning to Learn, compared to the non-linear learning to learn trend observed for the school sample. Comparing the graphs, it can be observed that high perseverative error couples with low conceptual response lead to very low learning to learn (the example is taken from the 15-year school cohort). Additionally, it can be observed that as perseverative error decreases

(YSCC sample), the learning to learn increases (YSCC sample).

Lastly, the graph of failure to maintain set indicates a gradual linear decrease in the YSCC participants, whereas the school sample indicates an observable drop in failure to maintain set in the 15-year cohort. Comparing to all the graphs above, failure to maintain set seems to follow the same trajectory as the conceptual level response. As such, results indicate that level failure to maintain set has some association with the conceptual level response, where an increase in conceptual level response (see *Figure 5.29* and *Figure 5.35,* 16-year school cohort) also leads to an increase in failure to maintain set and a decrease in conceptual level (see *Figure 5.29* and *Figure 5.35,* YSCC sample results) is reflected with a decrease in failure to maintain set.

#### *5.4.3.3 Summary.*

The WCST results indicate a few key differences between the two sample groups in terms of rule processing, conceptual understanding and perseverative error (cognitive inflexibility). Firstly, YSCC participants indicate a preference to rule recognition relating to colour and form, whereas school participants seem to show more development in terms of rule recognition of all 3 categories (colour, form and number). Additionally, each sample group follows a different age-related growth to rule recognition.

Secondly, results indicate that school participants have a more developed ability for conceptual thinking compared to YSCC participants. However, YSCC participants indicate better cognitive fluidity (referred to as mental-set shifting ability or adaptive control in the literature) in terms of low perseverative error, which decreases with age; whereas the school participants indicate a comparatively high perseverative error (cognitive inflexibility), which peaks at 15-years and then gradually decreases.

Thirdly, although there is a low conceptual level response in the YSCC participants, results indicate better scores for learning to learn which increases with age in YSCC participants. Comparing Learning to Learn with the perseverative error and conceptual response verifies that the increased cognitive flexibility present in YSCC participants (i.e. lower score for perseverative error) provides them with greater ability to change or shift their mental sets when faced with a change in rules, which in turn

influences their learning ability. In summary, the descriptive results imply that an improved ability to learn relies on cognitive flexibility more than the conceptual level response.

Lastly, failure to maintain set indicates some level of relationship with the conceptual level response, as such descriptive results indicate that level of conceptual understanding has a possible linear relationship with failure to maintain set. However, a factor analysis (analysed below) is conducted to confirm any correlations or clusters of the observed descriptive statistics of the ECF testing variables.

### 5.4.4 Principal Component Analysis

A principal component analysis (PCA) with orthogonal rotation (varimax) was conducted on the ECF test variables, from which 15 most viable items which test for ECF were chosen. The removal of outliers and testing of parametric assumptions yielded only a total of 58 participants from the entire sample of 104 viable for the PCA (data analysis excluded cases listwise for more generalisability of results).

#### *5.4.4.1 Exploring ECF Components in The Sample*

The Kaiser–Meyer–Olkin (KMO) measure indicated sampling inadequacy for the analysis, KMO = 0.492 ('poor' according to Field, 2013), which is also in line with other study recommendations noting any sample size smaller than 100 to be very poor (Field, 2013; Howell, 2013; Kyriazos, 2018). Bartlett's test of sphericity $\chi^2$ (91) = 347.921, $p < 0.001$, indicated that correlations between items were sufficiently large for PCA. The reproduced correlations table verifies that there are less than 50% of *non-redundant residuals with absolute values > 0.05*, as required (Field, 2013). The PCA correlation matrix indicates a determinant 0.001, which is within the recommended range of > 0.00001 (Field, 2013; Howell, 2013). As such, the assumption of no perfect multicollinearity is met (Field, 2013; Howell, 2013).

Six components had eigenvalues over Kaiser's criterion of 1 (Field, 2013; Howell, 2013), and explained a total of 76.68% of the variance. The scree plot verified the extraction of six components above the eigenvalues of 1, as such a total of 6 components were extracted. *Table 5. 32.* (below) summarizes the

factor loadings after the varimax rotation, the communalities, the eigenvalues extracted and percentage of variance explained.

Six components were extracted with communalities ranging between 0.64 to 0.943. Conceptual Response is the only testing variable which cross-loaded over two factors. Field (2013) and Howell (2013) suggest that all variables loading on a component with a 0.722 or higher can be marked as significant for a sample size of 50. However, due to the exploratory nature of the descriptive study coupled with the poor sample size and reliability, confirmation of the significance of items in each component was tested for using a *Multiple Analysis of Variance (*MANOVA).

Items that cluster on the same components suggest that component one represents the conceptual level and ability to shift mental set, component two represents the use of consequential thought in problem-solving, component three represents attentional inhibition, component four is planning and response inhibition, component five indicates distractibility after concept formation and component six indicates a level of impulsivity.

*Table 5. 32: Factor Analysis Results of ACF Components in the Sample*

| **Eigen Values** | **3.116** | **2.131** | **2.037** | **1.33** | **1.095** | **1.026** | |
|---|---|---|---|---|---|---|---|
| **Variables** | **Factor 1** | **Factor 2** | **Factor 3** | **Factor 4** | **Factor 5** | **Factor 6** | **Communalities** |
| Completed categories | **0.887** | 0.043 | 0.030 | 0.055 | 0.005 | -0.236 | 0.848 |
| % Preservative Error | **0.820** | -0.022 | -0.153 | 0.039 | 0.029 | -0.140 | 0.719 |
| % Conceptual Response | **0.719** | -0.031 | 0.020 | 0.084 | **0.554** | -0.142 | 0.853 |
| Learning to Learn | **0.594** | -0.198 | 0.161 | 0.008 | 0.326 | 0.351 | 0.647 |
| Tot. Extra Att. | 0.023 | **0.966** | -0.083 | -0.023 | -0.021 | 0.014 | 0.943 |
| No. Resets | -0.124 | **0.896** | 0.221 | -0.036 | 0.148 | -0.062 | 0.894 |
| Difference in Incongruent-Congruent responses | 0.062 | 0.108 | **0.766** | 0.010 | -0.177 | 0.222 | 0.684 |
| Mean RT correct incongruent /Mean RT correct control | -0.017 | 0.107 | **0.745** | 0.355 | -0.004 | -0.145 | 0.715 |
| Tot. Moves Excess | 0.201 | 0.330 | **-0.606** | 0.239 | -0.365 | 0.251 | 0.770 |
| % Planning T-Correct Solution | 0.152 | -0.064 | -0.017 | **0.868** | -0.023 | 0.036 | 0.783 |
| Prop. Correct - Incongruent | -0.101 | 0.016 | 0.353 | **0.664** | 0.132 | -0.309 | 0.689 |
| Failure to Maintain Set | 0.198 | 0.144 | -0.091 | 0.039 | **0.825** | -0.015 | 0.751 |
| No. Next Rounds | -0.200 | 0.122 | -0.017 | -0.238 | -0.226 | **0.693** | 0.643 |
| Trials - Complete First Category | -0.369 | -0.331 | 0.011 | 0.112 | 0.328 | **0.656** | 0.796 |
| % of Variation | 22.254 | 15.219 | 14.551 | 9.502 | 7.825 | 7.326 | |
| **Total Variation Explained** | | | | | | **76.68%** | |
| **Reliability** | | | | | | | **PCA Reliability** |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Cronbach α Based on Standardized Items | **0.794** | **0.779** | **0.079** | **0.512** | **0.696** | **0.371** | **0.494** |

*Principle Component Analysis (PCA) with Varimax Rotation*

Reliability of all components is calculated for research rigour. The *Cronbach α* reported verify component 3 to be unreliable; whereas components one, two and five report adequate reliability for an ability test (Field, 2013; Howell, 2013). An observation in terms of reliability, however, is that adequate reliability is only reported for components in which items from the same ECF test cluster. For example, components one and five comprise of only WCST items, while component two comprises of TOL items. As such, it may be plausible to get low levels of reliability due to the different tests measuring complex multi-dimensional constructs (Howell, 2013).

A Confirmatory Factor Analysis (CFA) was not performed post the PCA due to recommendations indicating that a sample smaller than 100 generates untenable results, as well as the recommendation that a CFA should consist of a sample greater than 200 participants (Kyriazos, 2018).

#### *5.4.4.2 Descriptive Differences in ECF*

Keeping in line with the descriptive design of the study, the underlying ECF components are discussed and compared between samples using descriptive findings between groups. To assist the reader with the descriptive discussions, relevant graphs and figures discussed in detail in the above sections are provided again. For the purpose of the discussions, a *Multiple Analysis of Variance* test was run to test for significant differences between sample groups and age-groups for each ECF component (as factorised above in *Table 5. 32*) with its multiple items.

Results from the MANOVA indicate no significant results for the interaction between sample groups and age-groups for all ECF components, except for component two representing *Consequential Thought* comprised of the items *Total Extra Attempts to Complete TOL* and *Number of Resets Used to Complete TOL*.

***Component 1: Conceptual Thought and Mental Set Shifting Ability (Adaptive Control)***

Items clustered in this component represent the ability for conceptual understanding of rules *(% of Total Conceptual Level Response* and *No. of Categories Completed*) as well as cognitive flexibility (*Perseverative Error* and *Learning to Learn).*

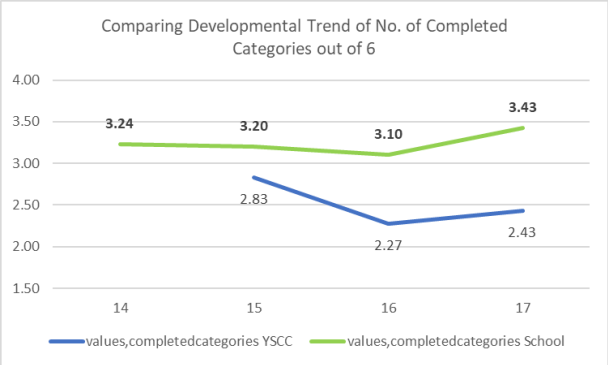



*Figure 5.36. Component 1 – Item 1*

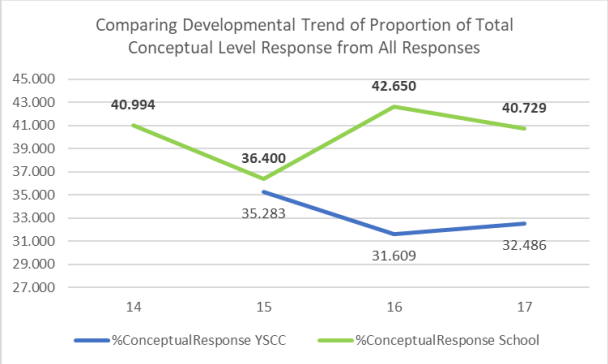



*Figure 5.37. Component 1 – Item 2*

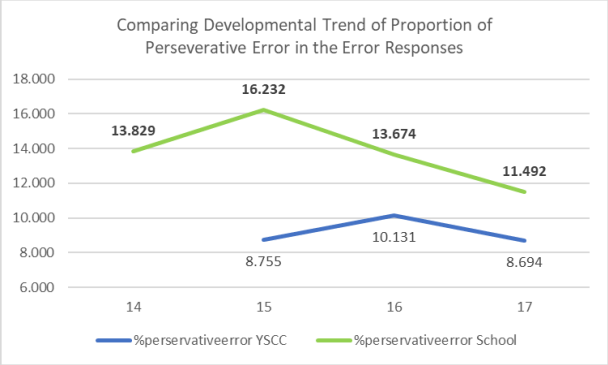
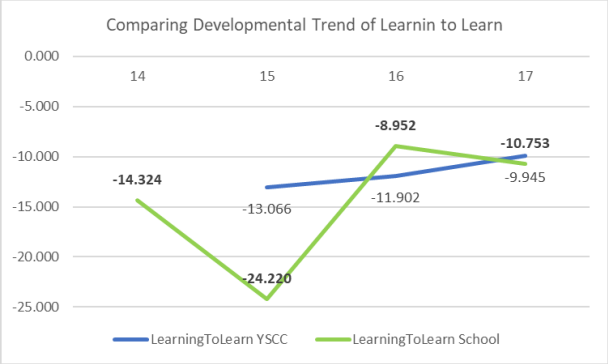



*Figure 5.38. Component 1 – Item 3*

To summarise the detailed discussed results above in *Section 5.4.3* (WCST Results), school participants score better on the ECF of conceptual understanding than the YSCC participants; however, the YSCC participants score better on adaptive control (i.e. low perseverative error), which also impacts their ability to learn better than school participants (see *section 5.4.3.3* for details). As discussed descriptively in *section 5.4.3*, *Learning to Learn* is impacted by the level of cognitive flexibility more than conceptual level response. However, descriptive graphs do not confirm if the differences between groups or ages are significant for the items which comprise this ECF component.

Results from the MANOVA for component 1 indicate no significant difference between the two sample groups [$F\ (4, 64) = 0.823, p > 0.05$], or the different age-groups [$F\ (12,169.6] = 0.898, p > 0.05$] based on conceptual understanding or cognitive flexibility. As such, although descriptive comparisons are observed between the two groups in terms of the ECF's, the difference between the two sample groups' development of conceptual understanding and cognitive flexibility does not significantly discriminate




between the sample or age groups. However, the descriptive results provide valuable insight into the developmental level and trend of the ECF between the two samples.

*Figure 5.39. Component 1 – Item 4*

***Component 2: Consequential Thought***

The following component comprises of two items from the TOL (*Extra Attempts* and *Average Number of Resets)*. As noted in *Section 5.4.1.2* (above), the *Total number of extra attempts* could have been influenced by *Number of Resets* and/or *Number of Extra Moves*. The component confirms a linear relationship of the number of extra attempts being due to the number of rests.

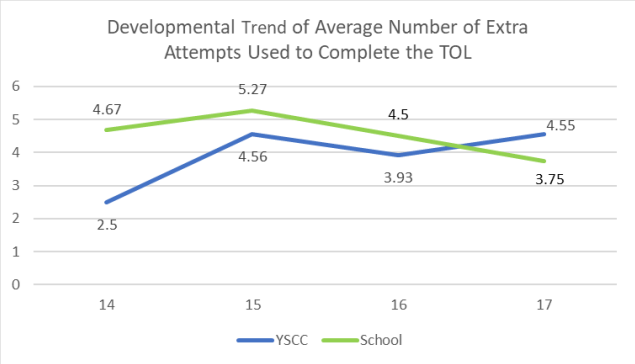



*Figure 5.40. Component 2 – Item 1*

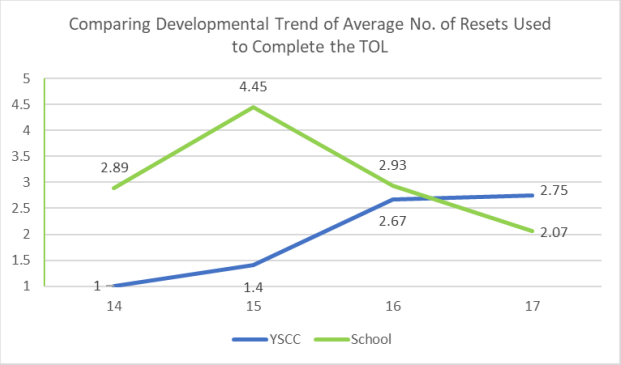



*Figure 5.41. Component 2 – Item 2*

As discussed in *Section 5.4.1.2 (p. 96)*, the extra number of resets is indicative of a participant being aware of an error and so resets the problem to attempt another approach for problem-solving, which leads to the high number of attempts. Additionally, the items of the current component seem to align with the abovementioned definition of relational reasoning/ consequential thought, which defines consequential thought as the ability to generate "appropriate alternative courses of action, but also the ability to sort through and decide which behaviours would result in the

appropriate outcome, and which would not" (Zeki et al., 2004, p. 1798).

The MANOVA results for component two indicate a significant interaction effect between sample groups and age for the ECF of consequential thought [*F (6,180) = 2.289, p < 0.05, Wilk's Lambda = 0.863, Partial* $\eta^2$ *= 0.071]* with an observed power of 0.787. Looking at further analysis, the results are significant for the item of *Number of Resets* [*F (3,91) = 3.051, p < 0.05, Partial* $\eta^2$ *= 0.091*] which indicated an observed power of 0.699. Correlating the significant findings with the descriptive mean comparisons between groups, results confirm that the school sample group *Reset* the problem-solving task significantly more times (*M = 2.964*) than the YSCC sample (*M = 2.429)*. More specifically, the 15-year school cohort indicates a significantly higher use of the *Reset* option (*M = 4.45)* than the YSCC 15-year cohort (*M = 1.4)*.

To summarise the results, the component of *consequential thought* has a significantly different presence between the two groups, where the school sample is aware of their errors and *Reset* more often, particularly the 15-year school cohort. Additionally, the *Extra Attempts* trajectory for the school group follows a similar path as the *No. of Resets*, yet the YSCC sample indicates a high number of extra attempts and a low number of resets. Following the discussion in *Section 5.4.1.2* (above), the YSCC sample's extra attempts can be observed as a consequence of the extra number of moves used to complete the task. However, as the *Extra Moves* item clustered into component 3 (below) as a negative correlation to the MRT and difference in the interference effect, as such the item translates to a possible result of impulsive clicking or response inhibition present in the YSCC participants as compared to the school sample's consequential thought. More details relating to response inhibition are discussed in the component below.

***Component 3: Attentional Inhibition and Response Inhibition***

The following component comprises of the items relating to the *Stroop MRT of proportion correct incongruent to correct control, Difference in MRT of Incongruent and Congruent Responses* and *Extra Moves for Completing TOL*. Items relating to the time taken to respond to an incongruent task (a task that contains an element of interference) are negatively correlated to the number of extra moves taken (i.e. response behaviour). As such, the correlational directionality indicates an increase in attention (i.e. time) when responding to distracting stimuli is negatively associated with an impulsive or automatic motor response behaviour (i.e. high number of extra moves). Due to this distinction between automatic response and use of attention in the face of distracting stimuli, the component speaks to inhibition. However, following guidelines of previous research introduced by Tiego et al., (2018), which makes distinctions between the two forms of inhibition, the component is divided into response inhibition and attentional inhibition.

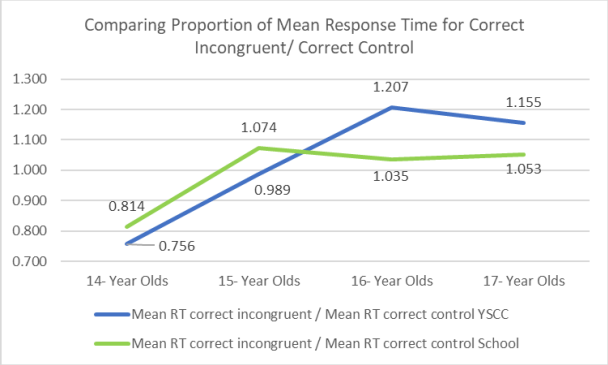



*Figure 5.42. Component 3 – Item 1*

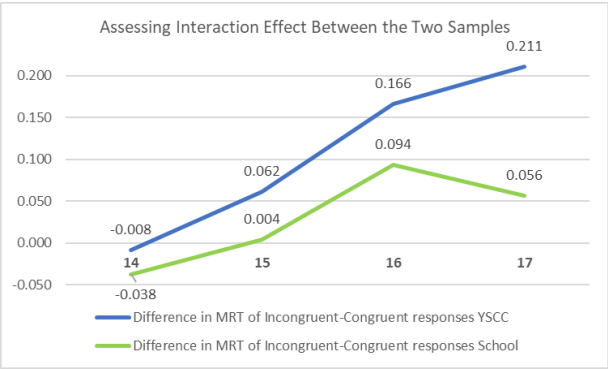



*Figure 5.43. Component 3 – Item 2*

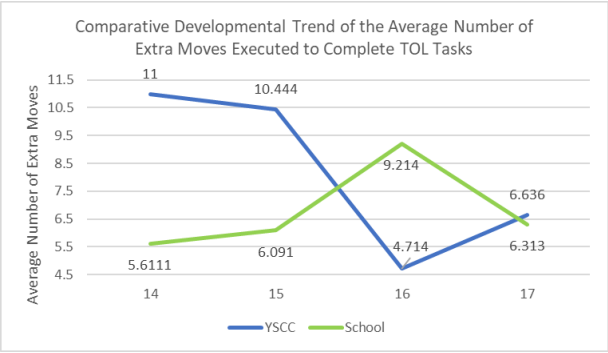



*Figure 5.44. Component 3 – Item 3*

The MANOVA results for component 3 indicated significant results between the age-groups of the two samples for the cognitive control function of of response inhibition and attentional inhibition, [*F (9,185.115) = 2.240, p < 0.05, Wilk's Lambda = 0.778, Partial* $\eta^2$*= 0.08]*. The significant difference indicates an observed power of 0.795.

Further analysis of the MANOVA indicates that the significant differences between the age-groups are noted for the items *MRT of proportion correct incongruent to correct control* and *Difference in MRT of Incongruent and Congruent Responses* (i.e. the items relating to the interference effect as discussed in *Section 5.4.2.2* above). However, when comparing the age-groups in the posthoc tests, none of the age-groups indicated significant differences between them. As such, there is a significant difference in response and attentional inhibition as age-progresses; however, there is no significant improvement or decline in inhibition between any age-group specifically. A rather important observation though, is that the YSCC 16-year cohort indicates the least number of extra moves and a fairly high score for the MRT during the interference effect. As such, compared to other age-groups, the YSCC 16-year cohort indicates a proportionately high level of attentional inhibition from participants of all other age-groups and sample groups. However, the reader is cautioned from making the mistake of assuming a high level of response inhibition as the discussion on *section 5.4.1.2* indicates that the YSCC 16-year cohort's low number of extra moves is due to a high level of *Next Rounds* (i.e. impulse response or low response inhibition).

A more relatable description of this component would be that YSCC sample participants require more time when using attention in the face of distracting stimuli, but are also more prone to automatic responses as compared to the school sample. However, the MANOVA results indicate no significant differences between the two sample groups in terms of this component.

***Component 4: Planning and Working Memory***

The following component comprises of the items testing *the average planning time used for a correct response* and *the proportion of correct incongruent results*. Component 4 is named *planning and working memory* as the component focusses on two major ECF's of planning through a complex task with the use of working memory to achieve correct results to a problem or an interference task. Additionally, the component of working memory aligns with the definition discussed in the literature, where working memory was defined as the cognitive skill to actively hold and manipulate temporary data in the mind (Nugent, 2013b).

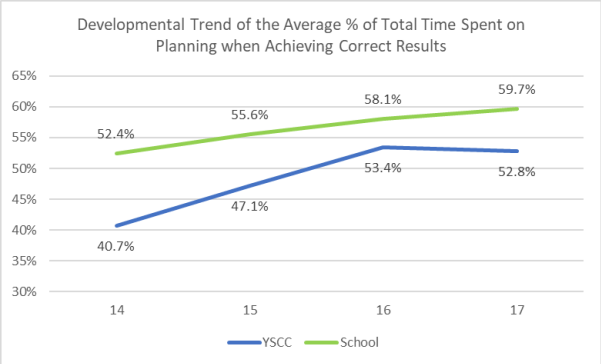



*Figure 5.45. Component 4 – Item 1*

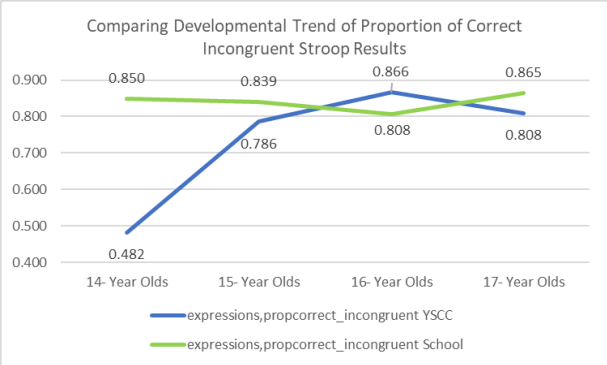



*Figure 5.46. Component 4 – Item 2*

The MANOVA results of component 4 confirm a significant difference between the two sample groups based on planning and working memory, [ *F (2, 86) = 9.377, p = 0.000, Wilk's Lambda = 0.821, Partial* $\eta^2$*= 0.179]* with an observed power of 0.975. Further analysis indicates that the significance between groups is present for both planning [*F (1, 87) = 13.417, p = 0.000, Partial* $\eta^2$*= 0.134]* and proportion of incongruent results correct [*F (1, 87) = 10.187, p = 0.002, Partial* $\eta^2$*= 0.105]* where each individual item yields an observed power greater than 0.88.

As such, results indicate that there is a significant difference between groups when it comes to the ECF use of planning and working memory. In both items, the school sample scores significantly greater than the YSCC sample indicating a greater ability to plan for a problem with the use of working memory (i.e. manipulating or holding information while responding to a distracting stimulus or solving a problem).

An interesting observation, however, is indicated in the YSCC 16-year cohort which yields the highest result for the proportion of correct incongruent, as well as the highest planning time in the YSCC sample. As such, despite the abovementioned observation of low response inhibition discussed for component 3, the 16-year YSCC cohort is capable of planning and manipulating important information in the face of a distracting stimulus.

***Component 5: Distractibility***

The following component speaks to the concept of distractibility as the component confirms a positive correlation between a conceptual understanding of a WCST rule and the inability to maintain the set for a certain number of cards (i.e. stop responding to the rule they had understood or picked up).

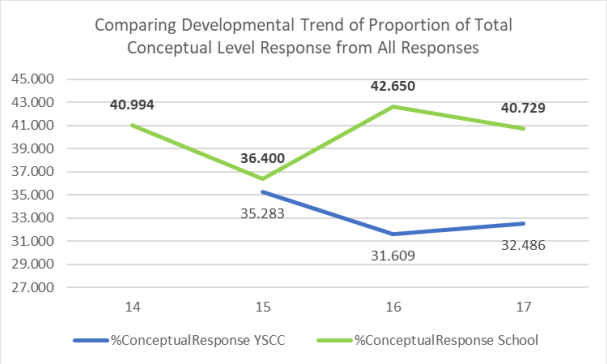



*Figure 5.47. Component 5 – Item 1*

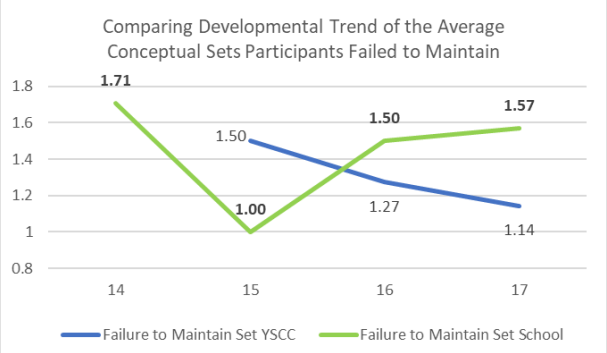



*Figure 5.48. Component 5 – Item 2*

The MANOVA results confirm a significant difference between the two sample groups based on distractibility, [*F (2, 76) = 3.795, p < 0.05, Wilk's Lambda = 0.909, Partial* $\eta^2$*= 0.091*] with an observed power of 0.675. Further analysis of the items indicates that only *conceptual response* yields significantly different results between the two sample groups when concerning distractibility, [*F (1,77) = 7.685), p < 0.05, Partial* $\eta^2$*= 0.091*] with a greater observed power of 0.789 than the observed power noted for differentiating between groups. Comparing the descriptive means, results confirm that the school sample scores significantly higher in conceptual response (*M = 42.02)* than the YSCC sample (*M = 34.97)*.

The significant difference between groups being a result of conceptual response makes sense as to understand a set of rules, conceptual understanding needs to be in place. However, just looking at the sample mean comparisons itself does not provide sufficient indication of the level of distractibility, although a low conceptual response can be due to distractibility preventing the formation of conceptual understanding, however, this cannot be measured with the current test results. As such, the data trends between failure to maintain set and conceptual response need to be referred to for more description of between-group differences.

Comparing the differences between the two abovementioned items, it can be observed that the 15 and 16-year age group cohorts between the two samples indicate a proportionately high level of failure to maintain set in relation to their conceptual level response. The most apparent difference is noted for the YSCC 15-year age group. As such, the results summarise that YSCC participants have a significantly lower conceptual level response, which may be a result of distractibility, and within the sample, the 15-year age group indicates a high level of distractibility in failing to maintain set and the 16-year YSCC cohort indicates a level of distractibility higher than that of the 17-year cohort.

***Component 6: Impulsivity***

Component six clustered items which translate to low response inhibition or impulsive response behaviour in terms of clicking *Next Round* and *No. of Trials to Complete the 1st WCST Category*. The component label of impulsivity seems in line with the definition discussed in the literature of this research, where impulsivity is defined as the inability of adolescents to inhibit actions without considering potential consequences (Congdon & Canli, 2008). The abovementioned definition seems to align well as the option of *Next Round* allows a participant to not solve an attempt for TOL and the *number if WCST trials to complete 1st category* is indicated within the component to be a consequence of just clicking cards without thinking of their choices.

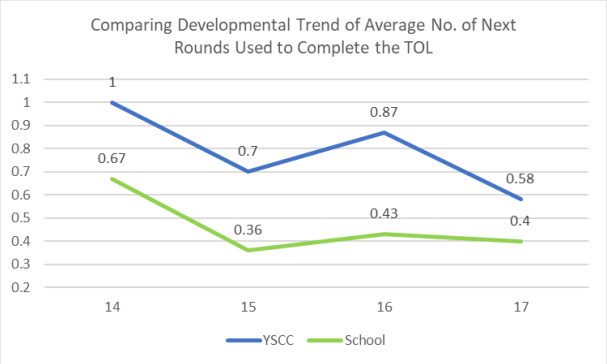



*Figure 5.49. Component 2 – Item 1*

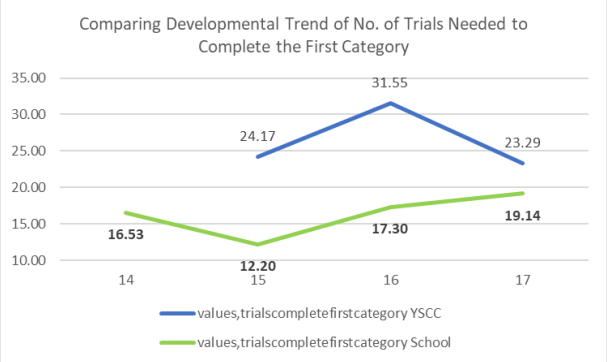



*Figure 5.50. Component 2 – Item 1*

The MANOVA results indicate no significant difference between the sample groups [*F (2, 68) = 0.973, p > 0.05*], or age-groups [*F(6,136) = 1.871, p > 0.05]*, or the interaction effect between the group and age groups [*F (6, 136) = 0.958, p > 0.05*].

As such, the component can descriptively indicate that the YSCC sample scores higher for impulsive response behaviour than school sample, however, the items of the component do not significantly differentiate between the sample groups or age-groups based on the ECF of distractibility. An interesting observation, however, is that the YSCC 16-year age-group is at high risk for impulsive behaviour responsiveness and show a relatively large observable difference in impulsive behaviour scores. Comparatively, the YSCC 15 and 17-year yield relatively lower impulsive behaviour than the 16-year YSCC cohort.

#### *5.4.4.3 Summary*

Of the 6 ECF components present between the two sample groups, component 1 (conceptual response and ability to shift mental set), component 3 (inhibition) and component 6 (impulsivity) indicate no significant difference between the two sample groups based on the ECF (i.e. cognitive skill). However, despite no significant difference, the descriptive information illustrates observable differences between the two sample groups in terms of preference of the cognitive skill. For example, in component 1, the school sample indicates a greater development for the conceptual response, but a lower development for mental-set shift ability, as compared to the YSCC sample which indicates an aptitude for learning and mental-set shift ability, but has an association with a low level of conceptual thought. Similarly, the YSCC sample indicates a greater need for time when using the cognitive skill of attention in distractible circumstances (attentional inhibition), but also indicate comparatively lower levels of response inhibition than the school sample. The result of component 3 then relates to the level of impulsivity as the YSCC sample indicate low response inhibition in component 3 which translates or correlates to low impulse control in behavioural responses. To summarise, components relating to concept formation,

cognitive flexibility and impulse control do not yield significant results, but they do still indicate observable differences between groups.

Additionally, component two relating to consequential thought is the only component from all 6 which tested significantly for differentiating between both the sample groups and the age-groups. The behaviour of resetting a problem due to understanding an error and wanting to try again to solve the problem from the information they have learnt is an ECF that is significantly higher in the school cohort compared to the YSCC. More specifically, the school 15-year cohort indicates a significant difference in their development of consequential thought as compared to the YSCC sample. The results indicate that as the practice of resetting decreases, their ability to work with consequential thought increases across the age group (see *section 5.4.1.2* for clarity on the discussion correlating the increase in total scores to a decrease in resets), while the ability for consequential thought gradually increases in the YSCC sample.

Lastly, component 5 (distractibility) and component 4 (planning and working memory) can significantly differentiate between the two sample groups, where the component of planning and working memory yields a strong score for observed power when differentiating between groups. To summarise the findings, the YSCC sample scores less for planning and working memory (except for the YSCC 16-year cohort who perform well for working memory) and the YSCC sample score significantly higher in terms of distractibility (analysed as the failure to maintain set relative to the conceptual level response).

# Chapter 6: Discussion and Conclusion

As indicated in *Section 4.1*, the results of the current research discussed in *Chapter 5* aimed to assess criminal capacity as a distinction of ECF and EI, and an exploration of how the findings correlate with the concept of hot cognition. As discussed in *Section 3.1*, hot cognition was hypothesised as the result of low EI (due to insufficient error regulation), accompanied by the vulnerability of reckless behaviour which was a result of an imbalance of ECF (i.e. impulsivity). Additionally, the research also considered known or associated risk factors as indicated by various authors (see Bartol & Bartol, 2014; Bezuidenhout 2013; Schoeman, 2016, Skelton & Badenhorst, 2011).

Current research findings confirm a significant difference in risk-taking behaviour, such as trying or socially using alcohol and drugs, present between youth in conflict with the law and youth not in contravention with the law. Additionally, in terms of domestic circumstances, the current sample confirmed a significant difference in the stability of their caregivers throughout their schooling years. As such, the above-mentioned results are in line with findings of various other studies and authors (Bartol & Bartol, 2014; Bezuidenhout 2013; Schoeman, 2016, Skelton & Badenhorst, 2011). However, current research findings did not correlate with those of Bartol & Bartol (2014) in terms of family history of incarceration being a risk factor of criminal capacity, as the current research findings indicated no descriptive differences between the two sample groups for the risk factor.

Additionally, demographic risk factors relating to education level (i.e. highest grade passed and the number of times they failed/repeated a grade) provided comparative descriptive results indicating an observable or apparent difference between sample groups, but could not be tested for significance due to insufficient sample numbers. The findings confirmed that none of the school participants (i.e. youth not in contravention with the law) failed more than one grade and that a large sample of the youth in contravention with the law tend to have a low level of education; and were in line with previous known or associated risk factors which are investigated by prosecutors in RSA when assessing any youth on trials (Skelton & Badenhorst, 2011). Although significance in the current research could not be tested for the education background differences, previous research confirms that the stability and quality of

caregivers, as well as the risk-taking behaviours of alcohol and drug use, do play an important role in how well the at-risk children perform at school (Bartol & Bartol, 2014; Bezuidenhout 2013; Schoeman, 2016).

Putting the abovementioned risk factors and risk behaviours aside, the current research's findings did confirm a significant difference in EI between the two sample groups and the ECF skills used. More particularly, the findings confirmed the abovementioned hypothesis of the use of hot cognition as the youth in conflict with the law scored significantly lower in certain EI areas, as well as a significantly lower score in error regulation (i.e. consequential thought component), while simultaneously scoring a fairly high score for distractibility and impulsive response behaviour.

The youth in conflict with the law scored significantly lower in 5 areas of emotional intelligence, namely; youth in conflict with the law : (1) struggle to persist in the face of challenges, (2) have a lower concern with positive self-presentation and the impression they leave on others, (3) have a lowered ability to motivate themselves, (4) have a low expectation of self, and lastly, (5) specific to the 16-year cohort, they lack the awareness of their own emotions. These areas of low EI match the latent EI factors of managing emotions, utilisation of emotions and perception of emotion which were proposed by Schutte et al., (2009). As such, the youth in conflict with the law do not score low for the factor of managing the emotions of others but score low for managing their own emotions or being aware of their own emotions. This sense of unawareness of one's own emotions or inability to persist in the face of a challenge contradicts the cold cognitive assumption of the Child Justice Act (2008) that youth from the age of 14 and above are responsible for blameworthiness as they have the ability for insight on socially acceptable behaviour. Alternatively, the findings are in line with Steinberg's (2012) explanation of adolescent decision-making being influenced by adolescent emotions and vulnerability, which implies a hot cognitive process for decision-making.

Additionally, the ECF components of the research confirm that the youth in conflict with the law utilise different ECF skills when responding to tasks. Firstly, findings confirm impulse responsiveness as an ECF used as a skill by all youth tested, which is argued by Pillay (2015), Kramers-Olen (2015), and

Steinberg (2005) to be the result of the adolescents' PFC still undergoing development as compared to the already developed amygdala, which controls the emotional responsiveness. Additionally, the ECF component of impulse responsiveness and distractibility present in all youth of the research contradicts Zeki et al's. (2004) argument of adolescent's capability of cold cognitive judgement which uses logical and idealistic reasoning. However, the ECF differentiation of criminal capacity covers six ECF components. Findings confirm that youth in contravention with the law have a significantly lower capacity for conceptual understanding, which was reflected in their inability to conceptualise the rule of number in the WCST. However, an unexpected finding was that they have a comparatively higher level of cognitive flexibility which assists them in the ability to learn. Additionally, the youth in conflict with the law are capable of attentional inhibition in the face of distracting stimuli, provided they are given the time to focus on the interfering stimulus.

The youth in conflict with the law also indicate an aptitude for planning and using working memory when facing interference and needing to require problem-solving. An interesting observation was noted in the Stroop discussion where the youth in conflict with the law respond better to the stimulus which has an interference of the lexicon with colour than to stimulus which had no interference (i.e. a plain block of colour). As such, it may be interesting to conduct further studies comparing results of cognitive interference aspects or emotional interference to test if the youth in conflict with the law tend to perform better in high stress or high strain environments due to their upbringing in such an environment itself (Bartol & Bartol, 2014). Additionally, as expected, findings confirmed a significantly lower level of consequential thought in the youth in conflict with the law, which can correlate with the ECF component confirming that the YSCC sample score low in conceptual understanding. As defined and discussed in the literature, consequential thought requires the ability to understand the consequence of outcomes (Zeki et al., 2004); however, if an individual is unable to form a conceptual understanding, then they are also not as capable of *appreciating the consequences of their actions*, which is a requirement for capacity as stated by the Child Justice Act (2008). Which brings the argument in line with the statement expressed by Pillay and Willows (2015) that even if the youth was capable of knowing right from wrong, they were lacking the ability to appreciate or understand the concept and its consequences.

In summary, the ECF skills used by the youth in conflict with the law indicate the ability to plan and use working memory in times of interference; however, they indicate a trend of responding impulsively and with a lower understanding of consequential thought or concept formation. As such, the YSCC participants indicate variation in the effective responsiveness of the PFC, which encompass planning, response inhibition, working memory and adaptive control (Pillay & Willows, 2015; Siddiqui et al., 2008; Zeki et al., 2004).

Having discussed the EI and ECF findings, it can be concluded that due to low consequential thought, low conceptual understanding and high impulsivity paired with the low ability to manage own emotions and ineffective utilisation of emotions, the youth in conflict with the law are at quite a high risk of using the hot-cognitive process for decision making. However, within the group of youth in conflict with the law, the 16-year age group is at the highest risk of criminal actions based on hot cognition. The one factor that places them to be more at risk is that they are the only age-group in the YSCC sample who scored significantly lower than all participants in awareness of their own emotions. Additionally, the age cohort scores comparatively low for concept formation and the relatively high for impulsivity within its sample. As such, the 16-year old youth in conflict with the law indicates a high risk for criminal activity based on a lack of PFC regulation and possible overdrive of the limbic cortex, which places them as high risk for risky decision making in an emotionally vulnerable scenario (Steinberg, 2012).

Lastly, the findings of this study also seem to be in line with Fischer's dynamic theory of development (Mascolo & Fischer, 2010) which underlies this study. The participants' findings indicate that similar to the demonstrations by Fischer and Bidell (2006), skills were developed through the various levels of the dynamic system within which the individual exists. As such, the participants' self (i.e. motivation, aptitude, belief, interest and risk-taking behaviours), the influence of others (i.e. stability in support of care-givers in skill growth) and the environment (i.e. possible high stress environment for YSCC participants) play a role on the level to which a skill develops, to what extent it developed and also under what environment the skill is performed at its best. Considering the findings by Bartol & Bartol (2014) with Fischer's demonstrations, the possible instability and high stress in the environment of children in conflict with the law may be a leading factor in why skills of working memory and problem

solving are performed better with a distracting stimulus. As such, the environment played a role in the development and activation of those skills. Additionally, Fischer also visualised that various skills develop at different levels at the same time with varying differences, which is observed in the differences between the two sample groups concerning concept formation and consequential thought. As such, given the dynamic system of self, other and environment and the metaphor of the spider web, this study visualised the different skills developed between the two samples at different levels and how they may be linked to certain external demographic factors.

In summary, they underlying theory of Fischer aptly adds to the understanding of skills development as dependent on various internal and external factors. The findings also confirm that cold cognitive theories of Kohlberg (1971) and Piaget (1971) of absolute maturation independent of external factors are not accurate in terms of adolescent development. As such, a dynamic theory is required when understanding the developmental process of adolescents, particularly those in contravention with the law.

### 6.1 Conclusion

The criminal capacity of adolescents does not follow a linear trajectory of PFC development. All adolescents still utilise the ECF of impulsivity and distractibility when making decisions. Findings of the empirical study confirm that youth in conflict with the law are more at risk for responsiveness guided by hot cognition as they show low understanding (concept formation) and low consequential thought; which is exacerbated by their inability to effectively manage emotions or to utilise them in times of need. However, within the YSCC sample, the 16-year cohort is at most risk for a hot cognitive response in times of stress, a cause of which is due to their lack of self-awareness of their own emotions. As such, criminal capacity when explored in terms of ECF and EI confirms the higher skill use of hot cognitive components in the youth in conflict with the law sample.

### 6.2 Limitations to the Study

Due to the exploratory nature of the research, the results obtained are tentative at best and cannot be thought of as definitive. Furthermore, due to the data analysis leaning towards a descriptive format, no causal inferences can be made. Therefore, the moderator or mediator effects of extraneous variables relating to developmental risk factors (i.e. socio-economic, familial, neighbourhood) were not explored.

Furthermore, the research findings are specific to the age group within this study, thus the findings cannot be used to comment on younger or older individuals. Additionally, due to the study only consisting of male participants, the findings cannot be generalised to the female populace or the females in conflict with the law. Lastly, the research is restricted to only one province of RSA, and so cannot reliably generalise the data for the country.

Additional limitations are noted in the form of sample size restrictions in terms of the number of the sample viable for data analysis as well as the restricted demographic area within Gauteng where the sample participants originate from. Although the test of power has been run for the sample size when comparing differences between groups for EI and ECF, the power test results, as well as the PCA results, indicate a poor sample size which does not allow for effective differentiation between groups unless specific items or components are tested for. Additionally, the YSCC 14-year age-group only comprised of two viable participants, which did not allow for any comparisons between the two sample groups for the age-group.

However, limitations aside, the strength of the study lies in it being the first empirical study in RSA to test for criminal capacity using valid neurocognitive tests. Additionally, it is also the first study to use a known reliable test to assess for EI. Additional strengths of the study include that three neurocognitive tests that test similar skills were used to confirm findings and assess skill development between the two sample groups.As such, the researcher concludes that findings of the current study are tentative at best, but do provide interesting and novel empirical results. The researcher would advise these findings be treated as the findings of a pilot study which can assist in advising diversion programmes but may require further investigations before advising the law.

### 6.3 Future Direction: Where to from here

The current research report can be viewed as a pilot exploration of the neurocognitive level of youth in RSA who have been caught for a crime. The present research results, although tentative, can be used as a proposed guideline to reassess the specific cognitive skills that should be tested for when assessing for the capacity of suspected youth during legal procedures. Based on current findings of the ECF and EI present between samples, the results indicate that the youth caught in suspicion of a crime are slow learners, but can learn. Additionally, the results confirm that the youth in YSCC require a diversion programme which works on promoting effective cognitive control through the development of consequential thought, specifically to the 16-year cohort. Additionally, results indicate that YSCC individuals require a programme which focusses more on building insight towards understanding their own emotions and managing emotions effectively enough to utilise them more constructively in times of need. Lastly, the research findings indicate a need to collect further data across the country to assist in setting future norms which can assist in assessing criminal capacity in a manner that has empirical backing.

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# Appendices

## Appendix A: Email from Xolani re youth centre demographics

From: Xolani Mpelane <Xolani.Mpelane@gauteng.gov.za>

Sent: Monday, 19 March 2018 3:53 PM

To: Maham Hasan

Subject: RE: Correspondence on Research

Hi Maham Hasan

Gauteng Social Development manages three secure care centres (for children in conflict with the law), namely:

1. [redacted] which is an outsourced centre, contact numbers [redacted]. Accommodates only boys (100) sentenced and (100) diversion, total capacity is 200/contracted number is 200.

2. [redacted], [redacted] and accommodates both boys and girls awaiting trial diversion.

1. [redacted] contact person [redacted] (HOI: [redacted]) [redacted] Cell: [redacted].This centre accommodates, sentenced, diverted and awaiting trial children (both boys and girls).

**Appendix B: School participant demographic questionnaire**


**School Participant Information Questionnaire**

*Please complete the following questionnaire and hand it in to the researcher at the end, once you have completed your participation.*

To complete the questionnaire, please note the following:

- You are welcome to leave out any questions you do not feel comfortable answering.
- You are welcome to ask the researcher to help you understand what is being asked in the questionnaire.
- You have been provided a person ID on your table. Please enter that number to complete the form.

---

| ***Participant ID:*** |
|---|

| Participant Name: | Date: | |
|---|---|---|
| Date of Birth: | Time: | |
| School: | Area: | |
| Have you ever been to court in suspicion of a crime? | □Yes | □ No |

| **Demographic Questionnaire** | | | |
|---|---|---|---|
| 1. What is your age? | □ 14 | □ 15 | □ 16 |
| | □ Other (Specify) | | |
| 2. What is your home language? | | | |
| 3. What other languages can you speak? | | | |
| 4. Do you use chronic medication? | □Yes | □ No | |
| 5. Do you drink alcohol? | □ Not at all | □ I have tried it | |

| | | |
|---|---|---|
| | □ Socially only | □ Often |
| 6. Do you use drugs? | □ Not at all | □ I have tried it |
| | □ Socially only | □ Often |
| 7. Have you ever had a head injury? | □ Yes, Mild | □ Yes, Major |
| | □ No | □ Don't know |
| 8. Have you ever been diagnosed with any problem that makes learning difficult for you? | □ Yes | □ No |
| | □ Don't know | |

| | | | |
|---|---|---|---|
| 9. How would you rate your concentration? | □ Good | □ Average | □ Weak |
| 10. How would you rate your memory? | □ Good | □ Average | □ Weak |

| | | |
|---|---|---|
| 11. Have you ever failed a grade? | □ Yes | □ No |
| 12. Grade/s repeated or failed | | |
| 13. What is the highest grade you have passed? | | |
| 14. What is the language of education at your school? | □ English | □ Afrikaans |
| | □ Other RSA Languages (specify) | |
| 15. How many children are in your class on average? | □ < 15 | □ 15 - 25 |
| | □ 25 – 35 | □ 35 < |
| 16. How would you rate the facilities in your school? | □ Top of the range | □ We have all the facilities |
| | □ We lack certain basic facilities | |

| | |
|---|---|
| 17. Who was your caregiver in pre-school?<br><br>*Note: Caregiver means someone who was taking care of you and your needs. This was the person you lived with and who took care of you after and before school.* | □ Both Parents<br>□ Single- Parent (mom/dad)<br>□ Grandparents<br>□ Aunts and/or uncles<br>□ Other Guardian: |
| | □ Both Parents |

| | |
|---|---|
| 18. Who was your caregiver in primary school? | □ Single- Parent (mom/dad) |
| | □ Grandparents |
| | □ Aunts and/or uncles |
| | □ Other Guardian: |
| 19. Who was/is your caregiver in high school? | □ Both Parents |
| | □ Single- Parent (mom/dad) |
| | □ Grandparents |
| | □ Aunts and/or uncles |
| | □ Other Guardian: |
| | □ Not Applicable |

| | | |
|---|---|---|
| 20. Who do you live with at home?<br>*Note: You can tick more than 1 box* | □ Single-parent | □ Both Parents |
| | □ Grandparents | □ Guardian |
| | □ Brothers | □ Sisters |
| 21. Has anyone from your family gone to jail for committing a crime? | □Yes | □ No |
| 22. How many people live in your home with you? | □ < 4 | □ 4 - 6 |
| | □ 6 - 8 | □ > 8 |
| 23. Are you the eldest child? | □ Yes | □ No |
| 24. How many bedrooms in your home? | | |
| 25. Do you have a domestic worker who cleans the house? | □ Yes | □ No |

| **Participant Declaration** |
|---|
| *Please read the following boxes and tick in agreement:* |
| □ I declare that all the information provided above is accurate and true.<br>□ I declare that the researcher did not force me to complete the questionnaire and that I provided the information of my own free will. |

**Appendix C: Youth centre participant demographic questionnaire**

**Youth Centre Participant Information Questionnaire**

*Please complete the following questionnaire and hand it in to the researcher at the end, once you have completed your participation.*

To complete the questionnaire, please note the following:

- You are welcome to leave out any questions you do not feel comfortable answering.
- You are welcome to ask the researcher to help you understand what is being asked in the questionnaire.
- You have been provided a person ID on your table. Please enter that number to complete the form.

---

| ***Participant ID:*** |
|---|

| | |
|---|---|
| Participant Name: | Date: |
| Date of Birth: | Time: |
| Centre: | Area: |
| Please tick the box that is relevant to you: | □ I have been charged for a crime, but am not placed in the rehabilitation programme. |
| | □ I am currently placed in the rehabilitation programme. |
| | □ I am currently on trial or waiting for a decision. |
| | □ I do not know my status. |

| **Demographic Questionnaire** | | | |
|---|---|---|---|
| 1. What is your age? | □ 14 | □ 15 | □ 16 |
| | □ Other (Specify) | | |
| 2. What is your home language? | | | |

| | | | |
|---|---|---|---|
| 3. What other languages can you speak? | | | |
| 4. How long have you been in the rehabilitation programme? | □ Not in the programme | | |
| | □ < 6 months | □ 6 – 12 months | |
| | □ 12 – 18 months | □ > 18 months | |
| 5. Do you use chronic medication? | □Yes | □ No | |
| 6. Do you drink alcohol? | □ Not at all | □ I have tried it | |
| | □ Socially only | □ Often | |
| 7. Do you use drugs? | □ Not at all | □ I have tried it | |
| | □ Socially only | □ Often | |
| 8. Have you ever had a head injury? | □ Yes, Mild | □ Yes, Major | |
| | □ No | □ Don't know | |
| 9. Have you ever been diagnosed with any problem that makes learning difficult for you? | □ Yes | □ No | |
| | □ Don't know | | |
| 10. How would you rate your concentration? | □ Good | □ Average | □ Weak |
| 11. How would you rate your memory? | □ Good | □ Average | □ Weak |

| | | |
|---|---|---|
| 12. Did you ever fail a grade when you were in school? | □ Yes | □ No |
| 13. Grade/s repeated or failed | | |
| 14. What is the highest grade you have passed? | | |
| 15. What was the language of education at your school? | □ English | □ Afrikaans |
| | □ Other RSA Languages (specify) | |
| 16. What was the name of the school you attended? | | |
| 17. What area was this school in? | | |
| 18. How many children were in your class on average? | □ < 15 | □ 15 - 25 |
| | □ 25 – 35 | □ 35 < |
| 19. How would you rate the facilities in your previous school? | □ Top of the range | □ We have all the facilities |

| | | |
|---|---|---|
| | □ We lack certain basic facilities | |
| 20. Who was your caregiver in pre-school?<br><br>*Note: Caregiver means someone who was taking care of you and your needs. This was the person you lived with and who took care of you after and before school.* | □ Both Parents | |
| | □ Single- Parent (mom/dad) | |
| | □ Grandparents | |
| | □ Aunts and/or uncles | |
| | □ Other Guardian: | |
| 21. Who was your caregiver in primary school? | □ Both Parents | |
| | □ Single- Parent (mom/dad) | |
| | □ Grandparents | |
| | □ Aunts and/or uncles | |
| | □ Other Guardian: | |
| 22. Who was/is your caregiver in high school? | □ Both Parents | |
| | □ Single- Parent (mom/dad) | |
| | □ Grandparents | |
| | □ Aunts and/or uncles | |
| | □ Other Guardian: | |
| | □ Not Applicable | |
| 23. Who do you live with at home?<br>*Note: You can tick more than 1 box* | □ Single-parent | □ Both Parents |
| | □ Grandparents | □ Guardian |
| | □ Brothers | □ Sisters |
| 24. Has anyone from your family gone to jail for committing a crime? | □Yes | □ No |
| 25. How many people live in your home with you? | □ < 4 | □ 4 - 6 |
| | □ 6 - 8 | □ > 8 |
| 26. Are you the eldest child? | □ Yes | □ No |
| 27. How many bedrooms in your home? | | |
| 28. Do you have a domestic worker who cleans the house? | □ Yes | □ No |
| **Participant Declaration** | | |
| *Please read the following boxes and tick in agreement:* | | |
| □ I declare that all the information provided above is accurate and true.<br>□ I declare that the researcher did not force me to complete the questionnaire and that I provided the information of my own free will. | | |

## Appendix D: Inquisit 5 Wisconsin Card Sorting Test example


*Figure 1*: Inquisit 5 WCST first page of instructions.

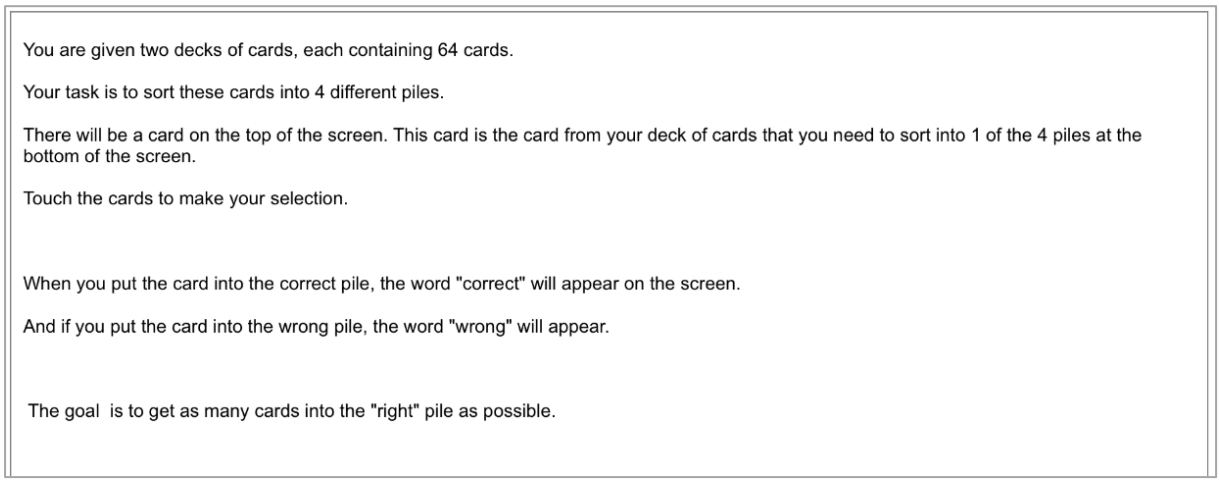


*Figure 2*: Inquisit 5 WCST second page of instructions.

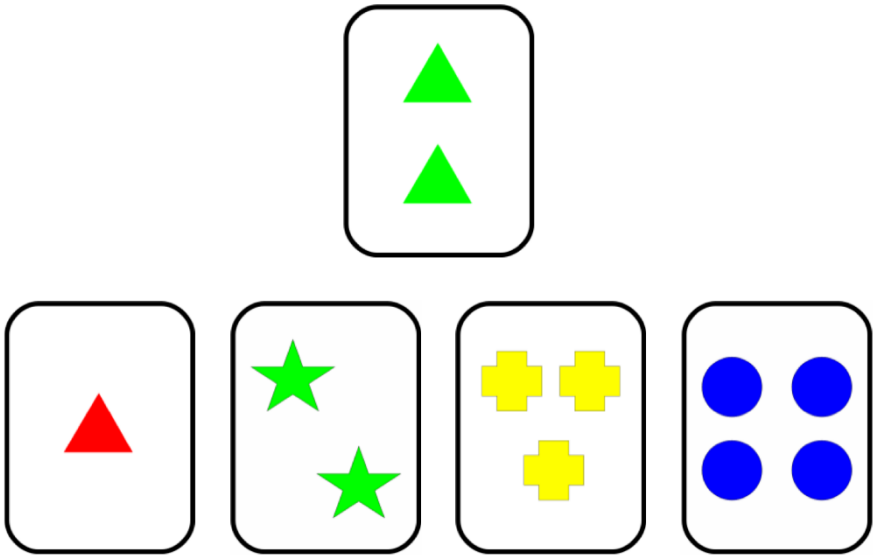

*Figure 3*: Example of the Inquisit 5 WCST test layout.

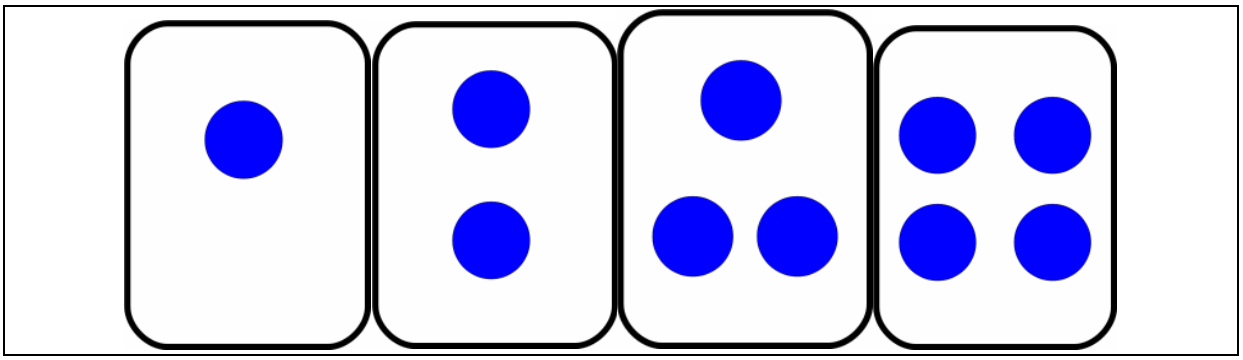

*Figure 4*: Inquisit 5 Wisconsin Card Sorting Test example illustrating the Blue Dot sorting cards in all Numbers provided by the programme.

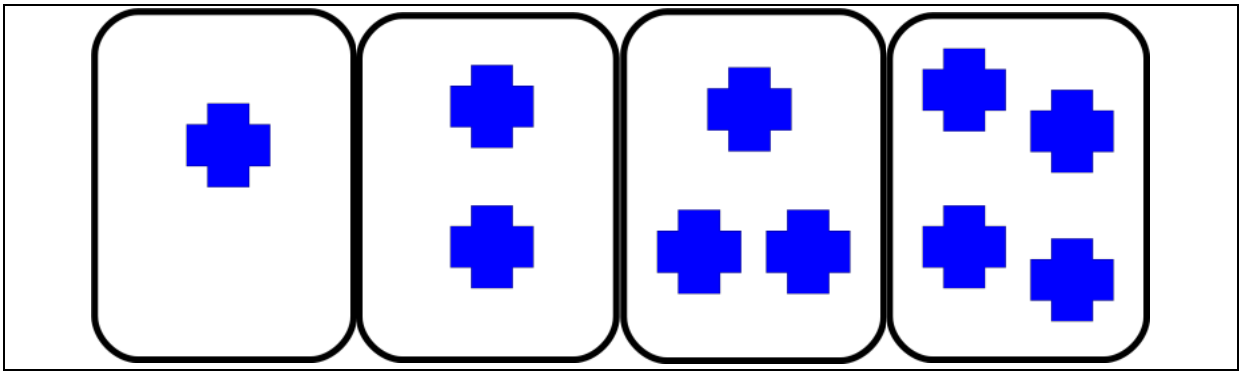

*Figure 5*: Inquisit 5 Wisconsin Card Sorting Test example illustrating the Blue Cross sorting cards in all Numbers provided by the programme.

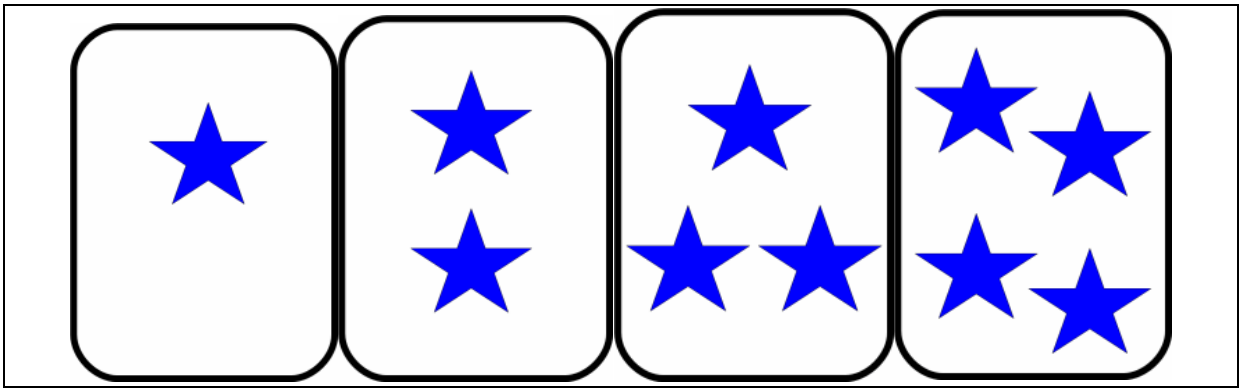

*Figure 6*: Inquisit 5 Wisconsin Card Sorting Test example illustrating the Blue Star sorting cards in all Numbers provided by the programme.

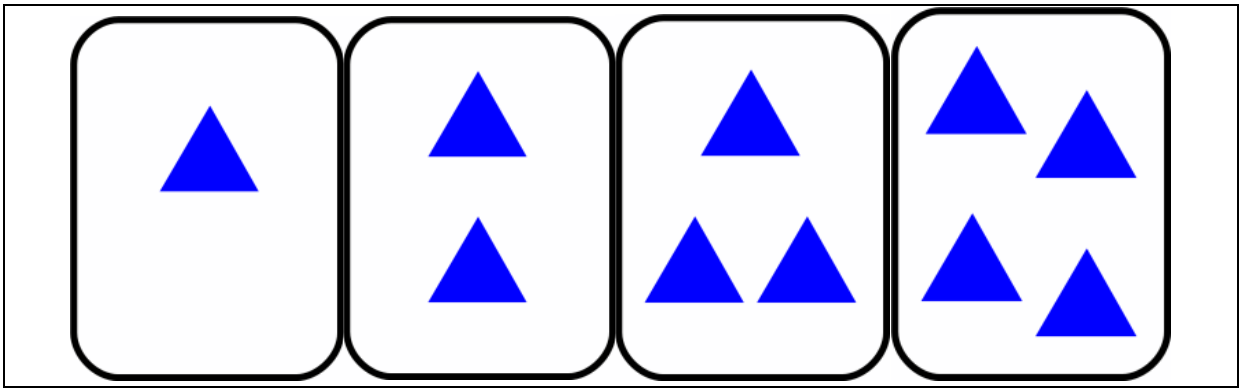

*Figure 7*: Inquisit 5 Wisconsin Card Sorting Test example illustrating the Blue Triangle sorting cards in all Numbers provided by the programme.

**Appendix E: Data Variables of the WCST (Millisecond Data)**

***Table 4.6.2.3.1***

*Raw Data provided on each participant from the Inquisit computer-based WCST, as indicated in the Millisecond Inquisit WCST Manual.*

| **Inquisit Wisconsin Card Sorting Test Raw Data File** | |
|---|---|
| **Summary variables title** | **What information variable column provides** |
| Date, time, subject/group: | Date and time script was run with the current subject/group number. |
| Block code/ Block no.: | The name and number of the current block. |
| Trial code/ Trial no.: | The name and number of the currently recorded trial. |
| Colour trial count/Form trial count/ Number trial count: | Sum up the trials run in the colour/form/number categories. |
| Total trials: | Counts the total trials run. |
| Category: | **1** = colour<br>**2** = form<br>**3** = number |
| Stimulus item: | The target card. |
| Stimulus item- stimulus item: | The selection of cards to choose from. |
| Response: | The participant's card selection. |
| Latency: | The response latency in milliseconds (ms). |
| Response Category: | Records features that the selected card (response) and the test card have in common<br>• CFN (colour, form, number);<br>• CF (colour; form);<br>• CN (colour, number);<br>• FN (form, number);<br>• C (colour);<br>• F (form);<br>• N (number);<br>• O (other) |
| Correct: | The correctness of the response. |
| Correct streak: | Counts consecutive correct responses.<br>**Note**: If an error is made, it's reset back to 0. |

| | |
|---|---|
| Perseverative Response: | **1** = response is still in compliance with the old rule after a rule switch (and no response has been made yet that violates the old rule).<br>**0** = any other response. |
| Sum Perseverative Responses: | Keeps a total of the number of perseverative responses made throughout the test. |
| Percent Perseverative Responses: | Percentage of *Perseverative Responses* of all trials. |
| Total correct: | Sums up all the correct responses across the task. |
| Total error: | Sums up all the incorrect responses across the task. |
| Sum Perseverative Error: | Sums up all error trials with values<br>*Perseverative Response* = 1 |
| Completed categories: | Number of categories (colour, form, number) successfully completed.<br>• min = 0<br>• max = 6 |
| Sum Failure to Maintain Set: | Keeps a total of the number of times a participant selects an incorrect card. |
| Trials complete first category: | Keeps track of how many trials a participant needed to complete the first category - after having maintained a correct streak of 5 or higher. |
| Error sum block: | Counts the errors in a block.<br>**Note**: Resets after each block. |
| Trial select card count: | Counts the number of cards dealt within a block. |
| PercentError_C1/.../PercentError_N2: | Percent errors in the first colour category .... percent errors in the second number category (etc.). |
| Diff_C1F1 etc.: | Difference scores of percent errors in adjacent categories.<br>• *Example:* Diff_C1F1 = percent errors in first colour category – percent errors in first form category).<br>**Note**: these scores are NOT updated on a trial basis. |
| Learning to Learn | Noted as a score of the ability to learn from feedback. |
| Card: | Determines which card to present (randomly selected from list select card). |
| Number of decks: | Counts the number of decks used (1-2). |
| Cards from a deck: | Counts the number of cards from a deck (1-64). |

***Table 4.6.2.3.2.***

*Summary Data provided on each participant from the Inquisit computer-based WCST, as indicated in the Millisecond Inquisit WCST Manual.*

| **Inquisit Wisconsin Card Sorting Test Summary Data File** | |
|---|---|
| **Summary variables title** | **What information variable column provides** |
| Script start date: | Date script was run. |
| Script start time: | Time script was started. |
| Script subject ID: | Subject ID number.<br>**Note**: This will be the participant ID provided by the researcher. |
| Script group ID: | Group ID number. |
| Script elapsed time: | Time it took to run script (in ms). |
| Computer platform: | The platform the script was run on/completed:<br>• 0 = script was not completed (prematurely aborted);<br>• 1 = script was completed (all conditions run) |
| cs_total trials: | Maximum Number of trials.<br>• Default = 128 → 2 decks x 64 cards. |
| cs_total blocks: | Maximum Number each category is tested.<br>• Default = 2 |
| Correct streak threshold: | Number of consecutive correct responses before a rule change.<br>• Default = 10 |
| Set maintain threshold: | Number of consecutive correct responses after which an incorrect response is scored as a "Failure to maintain Set".<br>• Default = 5 |
| Show deck info: | If set to " true" information about the deck (e.g. 1 of 2) and card number (e.g. 7 of 64) are displayed on the screen for the participant to see.<br>• Default = False |
| Colour trial count/Form trial count/ Number trial count: | Sum up the trials run in the colour/form/number categories. |
| Total trials: | Counts the total trials run. |
| Perseverative Response: | **1** = response is still in compliance with the old rule after a rule switch (and no response has been made yet that violates the old rule). |

| | |
|---|---|
| | **0** = any other response. |
| Sum Perseverative Responses: | Keeps a total of the number of perseverative responses made throughout the test. |
| Percent Perseverative Responses: | Percentage of *Perseverative Responses* of all trials. |
| Total correct: | Sums up all the correct responses across the task. |
| Total error: | Sums up all the incorrect responses across the task. |
| Sum Perseverative Error: | Sums up all error trials with values *Perseverative Response* = 1 |
| Completed categories: | Number of categories (colour, form, number) successfully completed.<br>• min = 0<br>• max = 6 |
| Sum Failure to Maintain Set: | Keeps a total of the number of times a participant selects an incorrect card. |
| Trials complete first category: | Keeps track of how many trials a participant needed to complete the first category - after having maintained a correct streak of 5 or higher. |
| PercentError_C1/.../PercentError_N2: | Percent errors in the first colour category .... percent errors in the second number category (etc.). |
| Diff_C1F1 etc.: | Difference scores of percent errors in adjacent categories.<br>• *Example:* Diff_C1F1 = percent errors in first colour category – percent errors in first form category).<br>**Note**: these scores are NOT updated on a trial basis. |

## Appendix F: Inquisit 5 Tower of London task examples

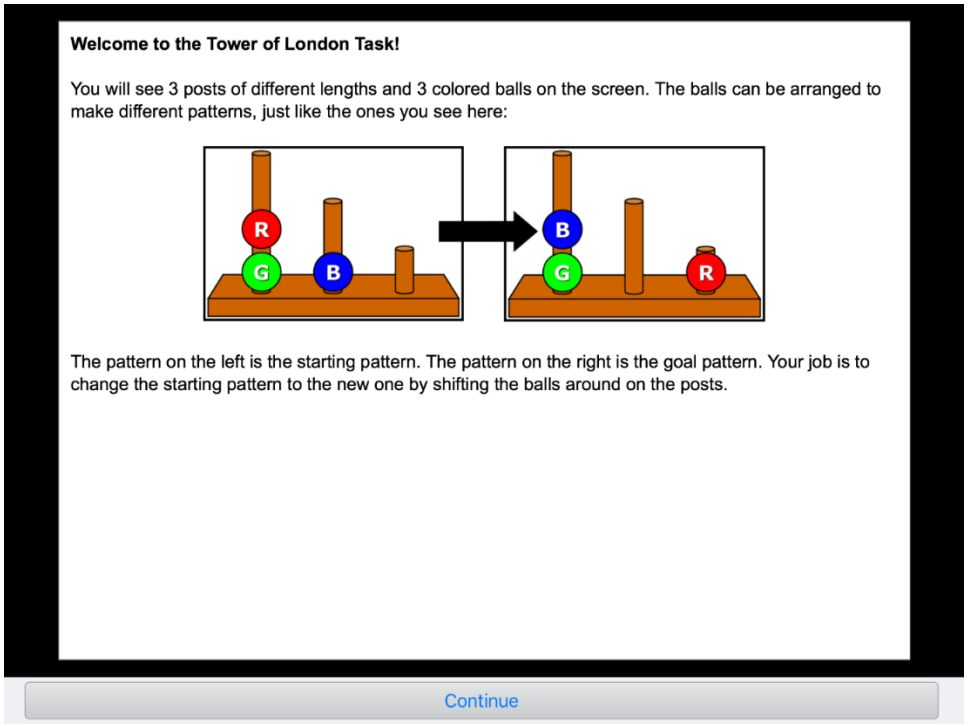


*Figure 8*: Inquisit 5 TOL first page of instructions.

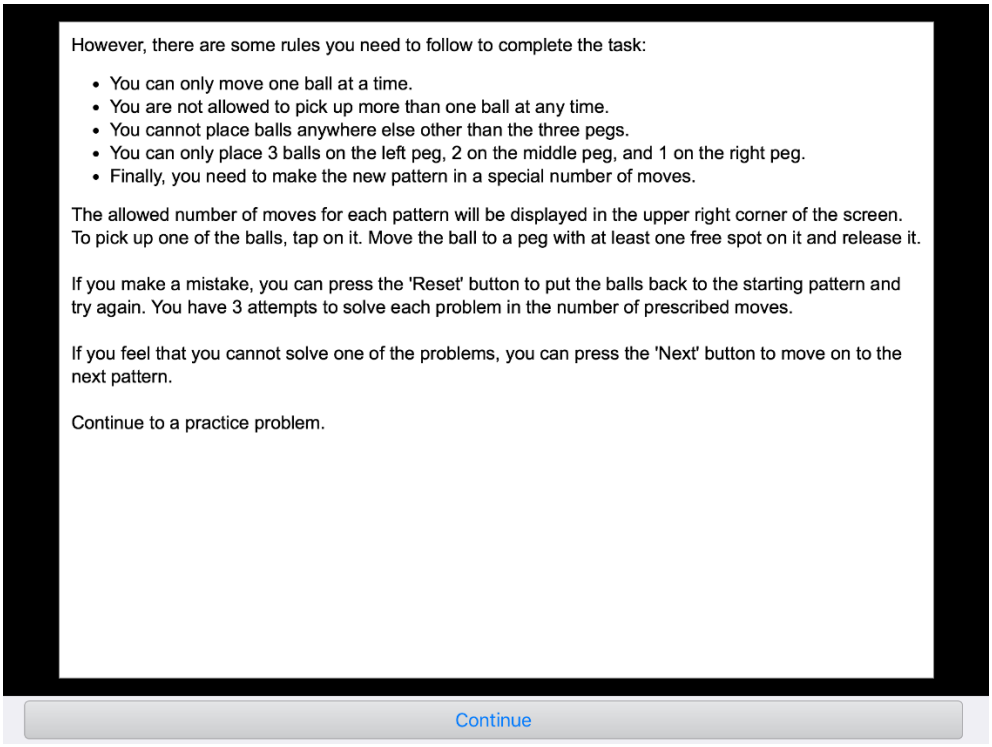


*Figure 9*: Inquisit 5 TOL second page of instructions.

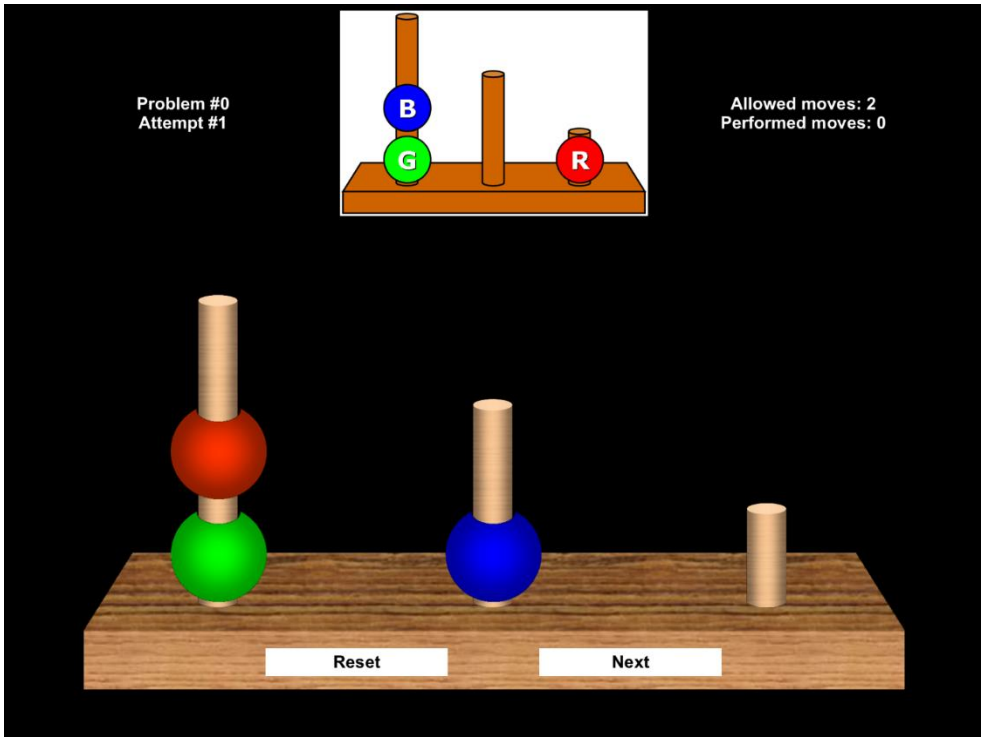


*Figure 10*: Inquisit 5 TOL picture of the trial run within the programme.

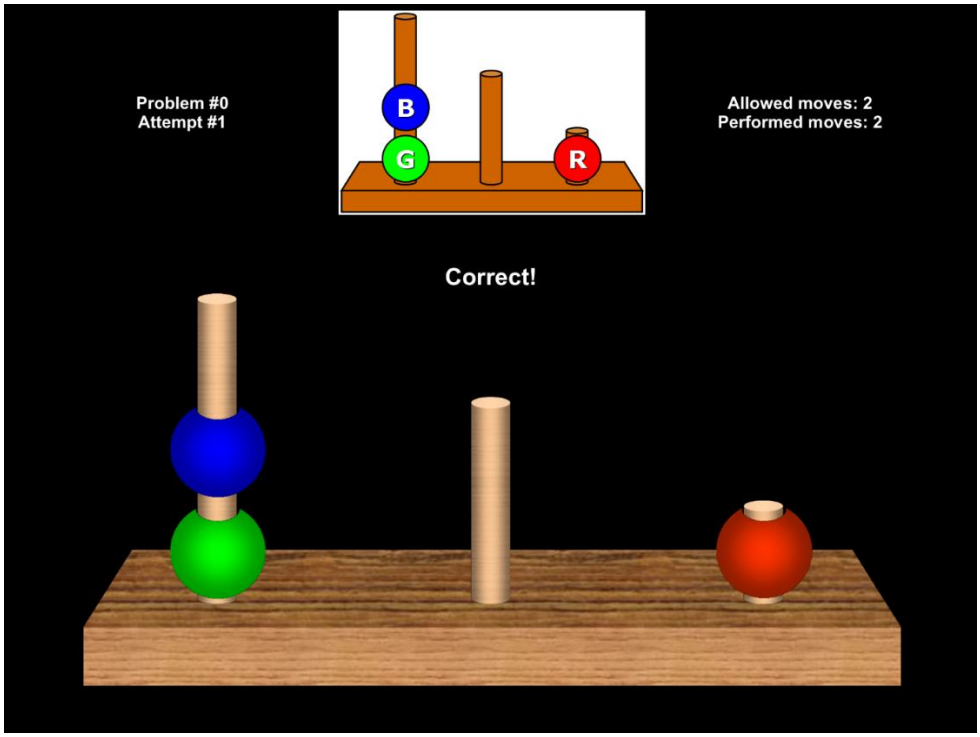


*Figure 11*: Example of how feedback is provided for correct solution in the TOL task within the Inquisit 5 programme.

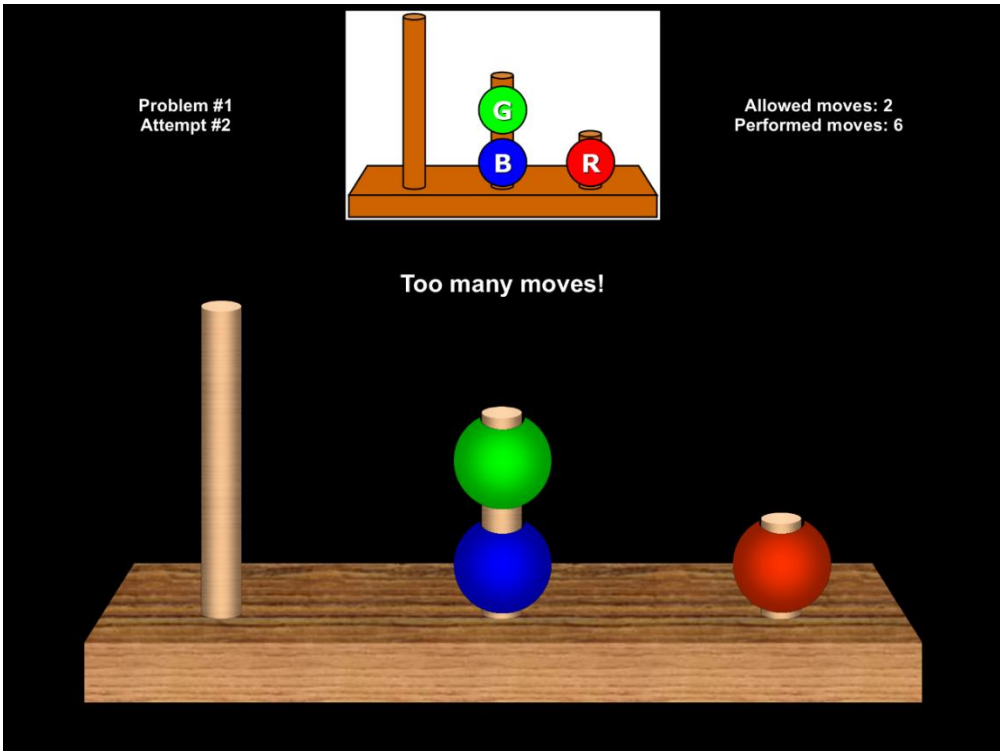


*Figure 11*: Example of how feedback is provided when performing extra moves in the TOL task within the Inquisit 5 programme.

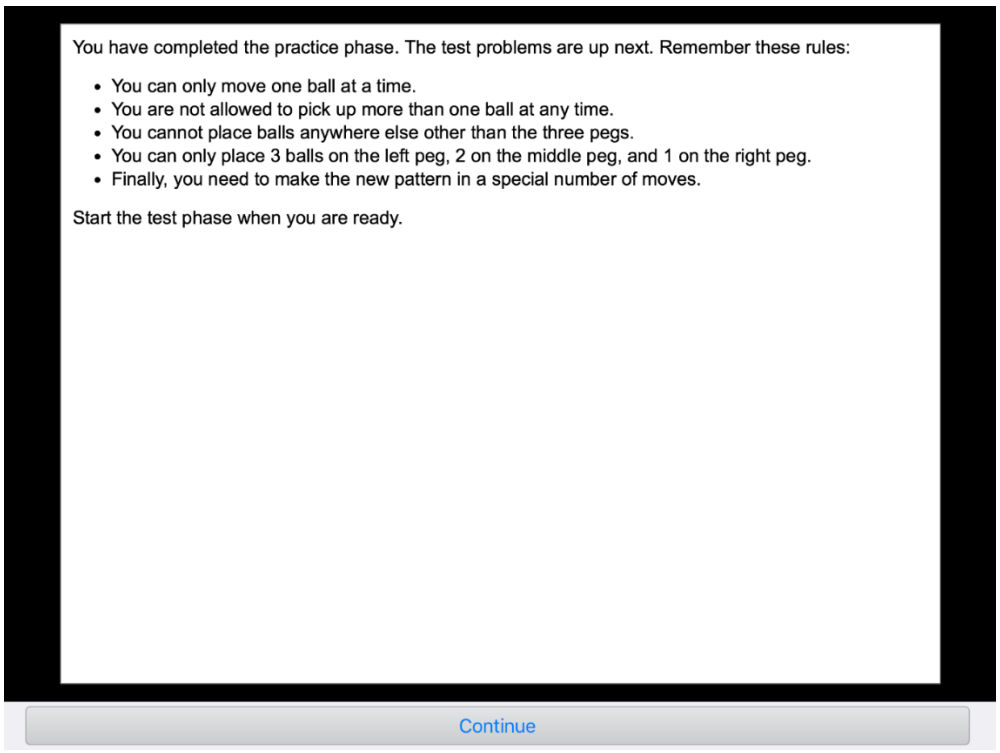


*Figure 12*: Inquisit 5 TOL instructions page after trial run.

**Appendix G: Images of the 12 problems in the Inquisit 5 TOL task**

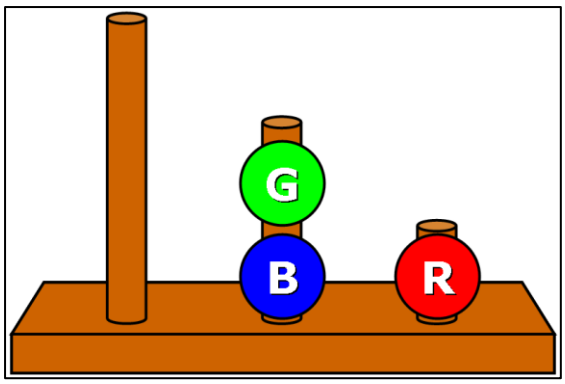


*Figure 13*: Tower of London Task *Problem 1*, as illustrated by the Millisecond Inquisit 5 lab programme.

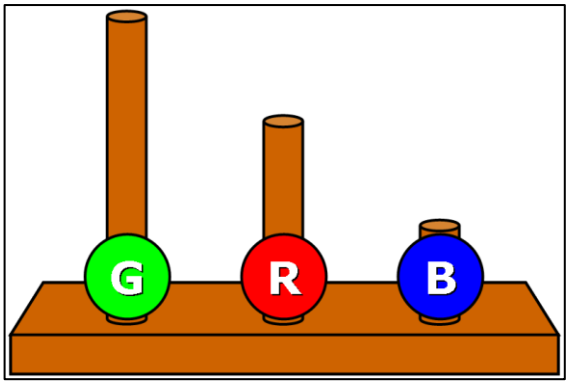


*Figure 14*: Tower of London Task *Problem 2*, as illustrated by the Millisecond Inquisit 5 lab programme.

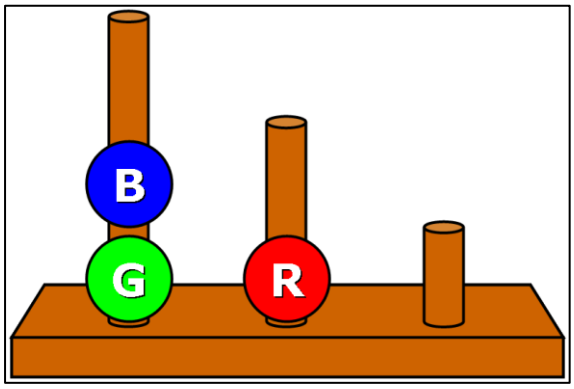


*Figure 15*: Tower of London Task *Problem 3*, as illustrated by the Millisecond Inquisit 5 lab programme.

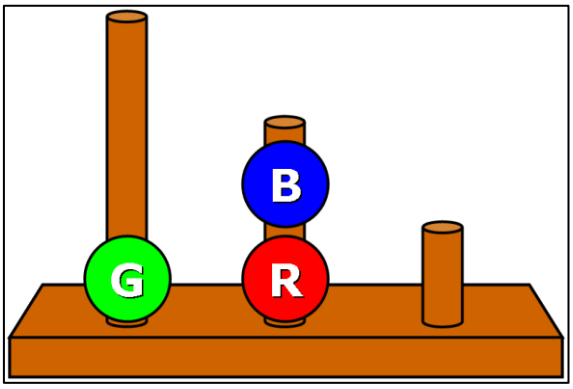


*Figure 16*: Tower of London Task *Problem 4*, as illustrated by the Millisecond Inquisit 5 lab programme.

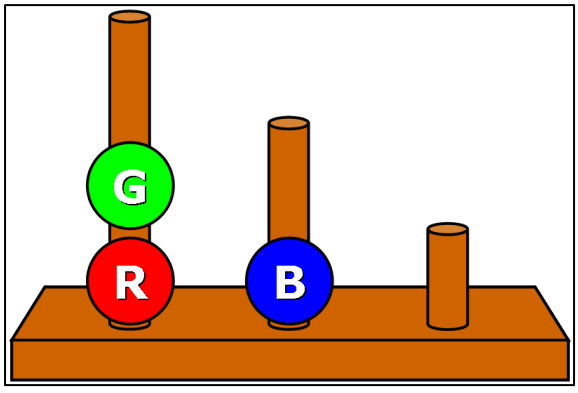


*Figure 17*: Tower of London Task *Problem 5*, as illustrated by the Millisecond Inquisit 5 lab programme.

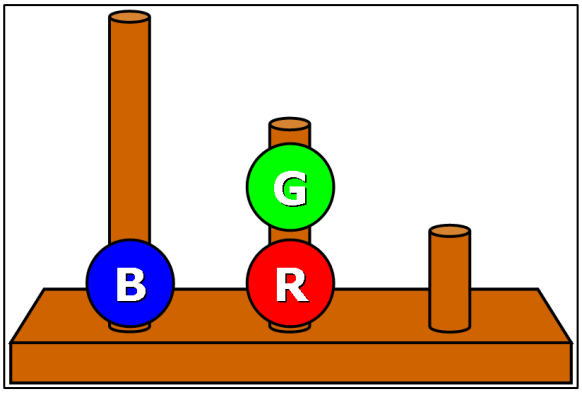


*Figure 18*: Tower of London Task *Problem 6*, as illustrated by the Millisecond Inquisit 5 lab programme.

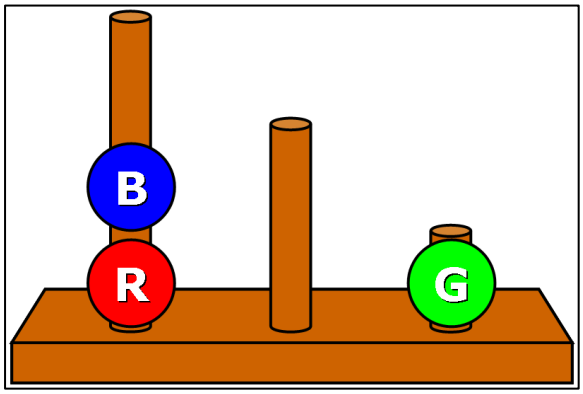


*Figure 19*: Tower of London Task *Problem 7*, as illustrated by the Millisecond Inquisit 5 lab programme.

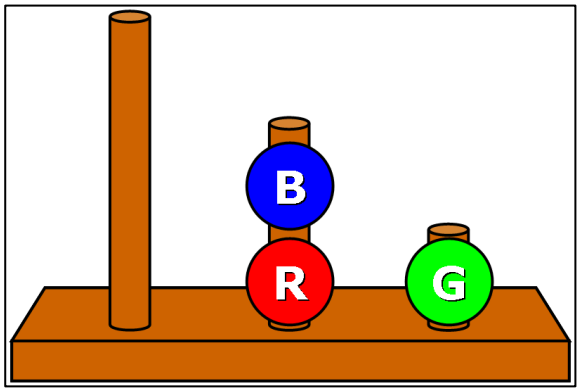


*Figure 20*: Tower of London Task *Problem 8*, as illustrated by the Millisecond Inquisit 5 lab programme.

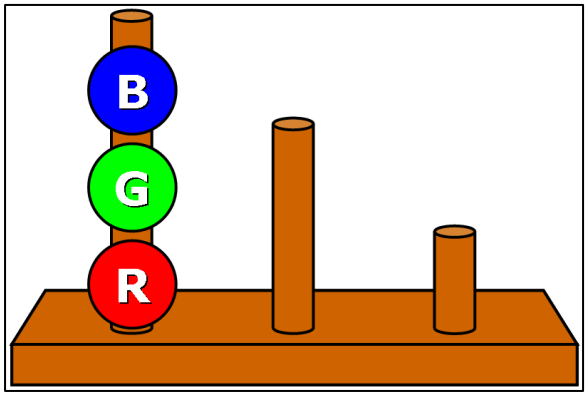


*Figure 21*: Tower of London Task *Problem 9*, as illustrated by the Millisecond Inquisit 5 lab programme.

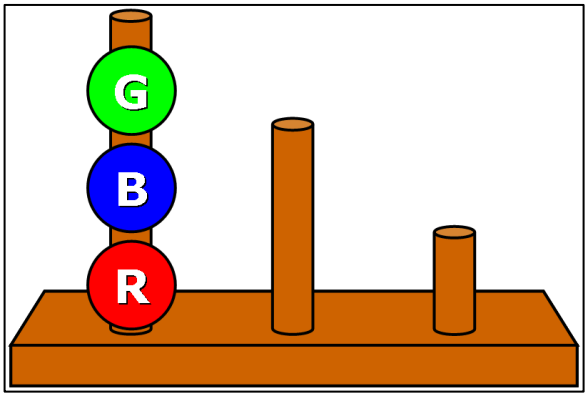


*Figure 22*: Tower of London Task *Problem 10*, as illustrated by the Millisecond Inquisit 5 lab programme.

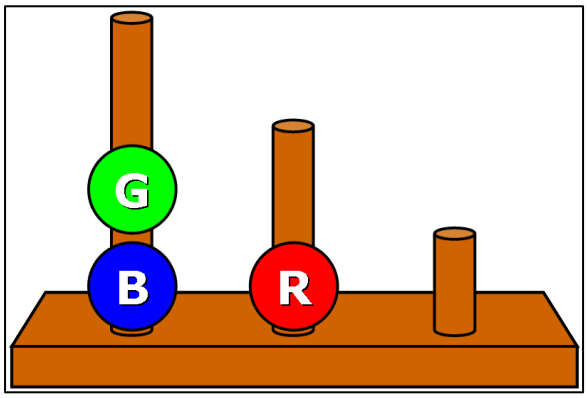


*Figure 23:* Tower of London Task *Problem 11*, as illustrated by the Millisecond Inquisit 5 lab programme.

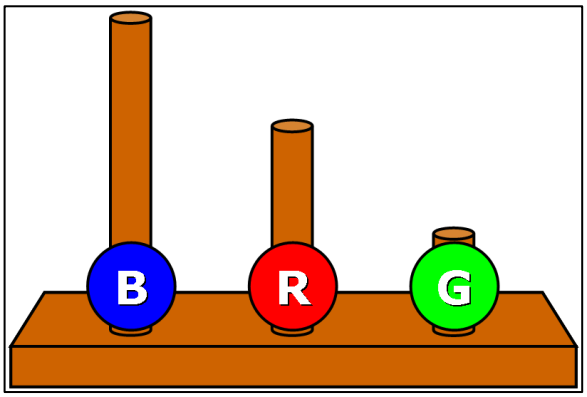


*Figure 24*: Tower of London Task *Problem 12*, as illustrated by the Millisecond Inquisit 5 lab programme.

**Appendix H: Data Variables of the TOL (Millisecond)**

***Table 4.6.3.4.1.***

*Raw Data provided on each participant from the Inquisit computer-based TOL, as indicated in the Millisecond Inquisit TOL Manual.*

| **Inquisit Tower of London Raw Data File** | |
|---|---|
| **Summary variables title** | **What information variable column provides** |
| Date, time, subject/group: | Date and time script was run with the current subject/group number. |
| Block code/ Block no.: | The name and number of the current block. |
| Trial code/ Trial no.: | The name and number of the currently recorded trial. |
| Response: | The participant's response made. |
| Latency: | The response latency in milliseconds (ms). |
| Problem number: | Current problem number.<br>• By default, the task consists of 1 practice problem and 12 test problems presented sequentially.<br>• 0 indicates a practice problem. |
| Subject attempts: | Number of current attempts to solve the given problem. |
| Target moves: | Number of prescribed moves for the current problem. |
| Subject moves: | Number of subject-performed moves for the current problem. |
| Excess moves: | Returns the difference between number of moves performed by the subject and the number of targets moves for a given problem. |
| Move string: | Text string containing a record of performed moves.<br>• *E.g.* "B2R3" → indicates that the blue ball (B) was moved to peg 2 (center) and the red ball (R) was moved to peg 3 (right). |
| Target achieved: | Returns true as soon as the subject has successfully reached a given problem's target / goal state. Otherwise stated as false. |
| Problem score: | Score awarded for solving the current problem.<br>• *See Krikorian et al. (1994) for details, or see Appendix H.* |

| | |
|---|---|
| Total score: | Score achieved across the whole set of test problems.<br>• Computed as the sum of individual problem scores.<br>• Maximum is 36 in the standard version. |
| First move time: | Returns the time (in ms) elapsed between initial presentation of the target configuration and the initialization of the subject's first move.<br>• Sometimes also referred to as "planning time" or simply "latency".<br>**Note**: Measure is computed separately for each attempt. |
| Execution time: | Computed as solution time – first move time.<br>**Note**: Measure is computed separately for each attempt. |
| Solution time: | Returns the time (in ms) elapsed between initial presentation of the target configuration and a subject's successful solution.<br>**Note**: Measure is computed separately for each attempt. |
| t_choice start: | Absolute start time for trial choice (in ms).<br>• May be used to derive additional measures during data analysis (e.g. mean move time). |
| t_choice end: | Absolute end time for trial choice (in ms).<br>• May be used to derive additional measures during data analysis (e.g. mean move time). |

***Table 4.6.3.4.2.***

*Summary Data provided on each participant from the Inquisit computer-based TOL, as indicated in the Millisecond Inquisit TOL Manual.*

| **Inquisit Tower of London Summary Data File** | |
|---|---|
| **Summary variables title** | **What information variable column provides** |
| Script start date: | Date script was run. |
| Script start time: | Time script was started. |
| Script subject ID: | Subject ID number. |
| Script group ID: | Group ID number. |
| Script elapsed time: | Time it took to run script (in ms). |
| Computer platform: | The platform the script was run on. |
| Completed: | **0** = script was not completed (prematurely aborted).<br>**1** = script was completed (all conditions run). |
| Total score: | Score achieved across the whole set of test problems.<br>• Computed as the sum of individual problem scores.<br>• Maximum is 36 in the standard version. |
| Mean Solution Time: | The mean solution time (in ms) of all solutions with *Solution Time* > 0. |
| SD Solution Time: | The standard deviation (in ms) of solution times of solutions with *Solution Time* > 0. |
| Mean Execution Time: | The mean execution time (in ms) of all solutions with *Solution Time* > 0. |
| SD Execution Time: | The standard deviation (in ms) of all execution times of all completed solutions with *Solution Time* > 0. |
| Mean Solution Time _ Correct Solution: | The mean solution time (in ms) of all solutions with values *Problem Score* > 0. |
| SD Solution Time _ Correct Solution: | The standard deviation (in ms) of solution times of solutions values *Problem Score* > 0. |
| Mean Execution Time _ Correct Solution: | The mean execution time (in ms) of all solutions with values *Problem Score* > 0. |
| SD Execution Time _ Correct Solution: | The standard deviation (in ms) of all execution times of all completed solutions with values *Problem Score* > 0. |

## Appendix I: Inquisit 5 Stroop Word-Colour Task example

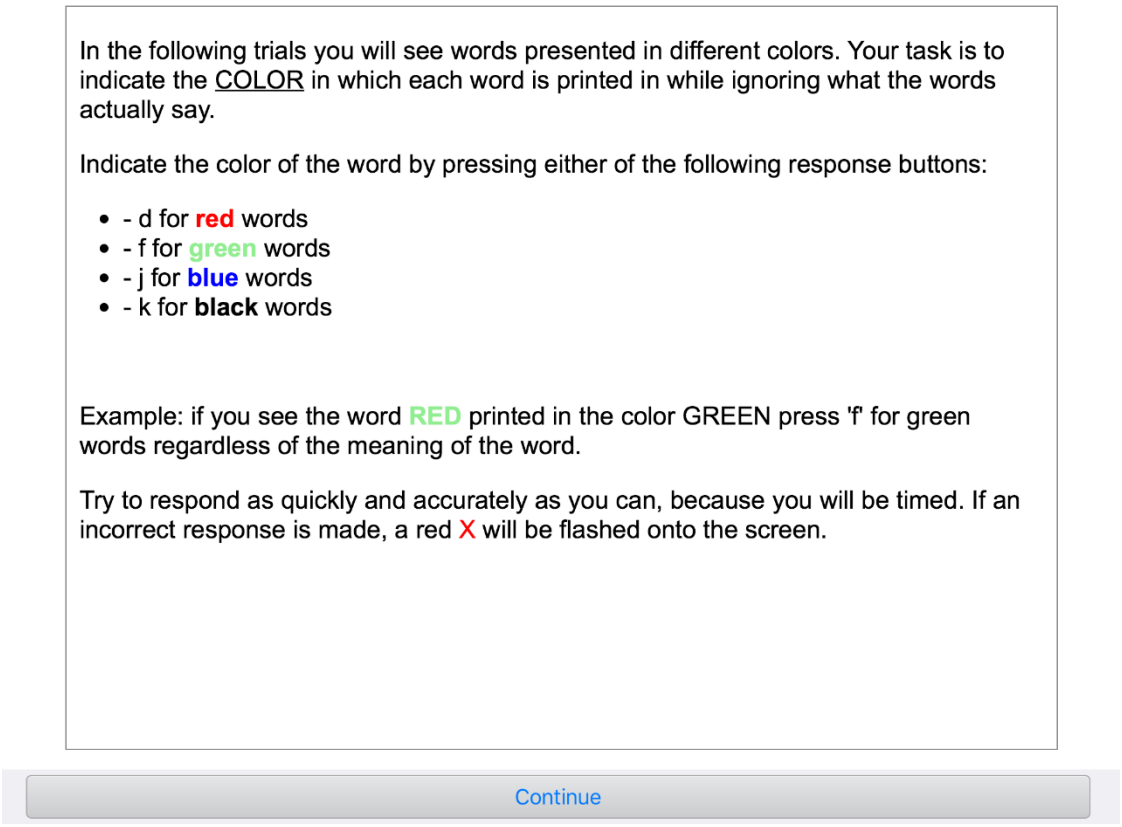


*Figure 25*: Inquisit 5 Stroop Word-Colour Task first page of instructions.


*Figure 26*: Inquisit 5 Stroop Word-Colour Task second page of instructions.

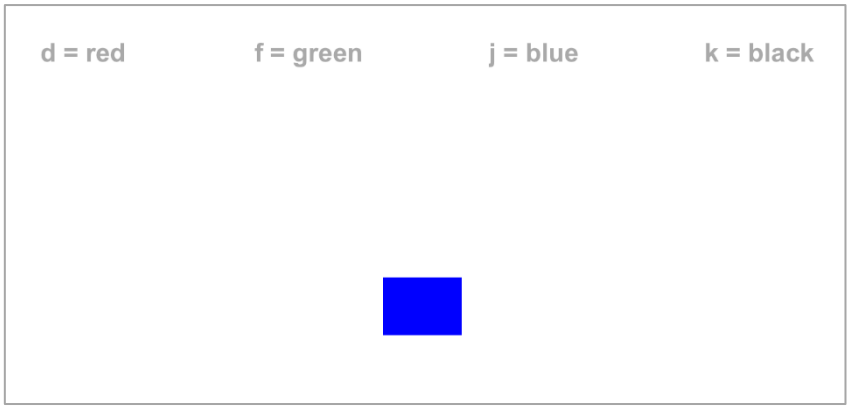


*Figure 27*: Inquisit 5 Stroop Word-Colour Task example of control.

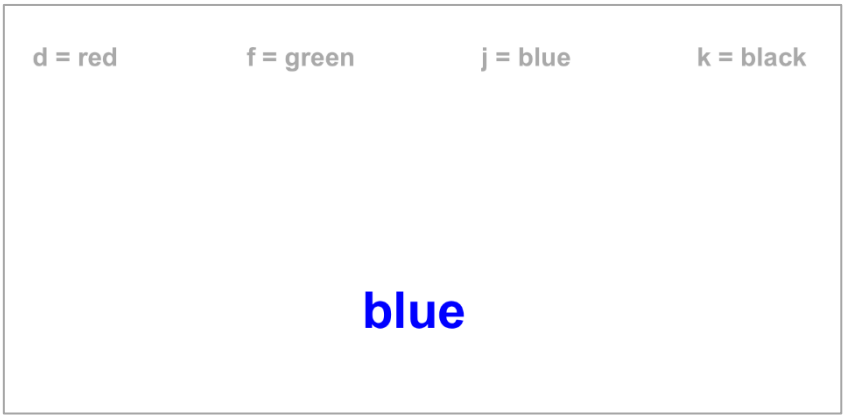


*Figure 28*: Inquisit 5 Stroop Word-Colour Task example of a congruent.


*Figure 28*: Inquisit 5 Stroop Word-Colour Task second page of instructions.

**Appendix J: Data Variables of the Stroop Colour-Word (Millisecond)**

***Table 4.6.4.4.1.***

*Raw Data provided on each participant from the Inquisit computer-based Stroop Colour-Word Task, as indicated in the Millisecond Inquisit Stroop Colour-Word Manual.*

| **Inquisit Stroop Colour-Word Task Raw Data File** | |
|---|---|
| **Summary variables title** | **What information variable column provides** |
| Date, time, subject/group: | Date and time script were run with the current subject/group number. |
| Block code/ Block no.: | The name and number of the current block. |
| Trial code/ Trial no.: | The name and number of the currently recorded trial. |
| Congruency: | **1** = congruent<br>**2** = incongruent<br>**3** = control |
| Stimulus item: | The presented stimuli in order of trial presentation. |
| Response: | The participant's response. |
| Correct: | The correctness of the response.<br>• **1** = correct<br>• **0** = incorrect |
| Latency: | The response latency (in ms). |

***Table 4.6.4.4.2.***

*Summary Data provided on each participant from the Inquisit computer-based Stroop Colour-Word Task, as indicated in the Millisecond Inquisit Stroop Colour-Word Manual.*

| **Inquisit Stroop Colour-Word Task Summary Data File** | |
|---|---|
| **Summary variables title** | **What information variable column provides** |
| Script start date: | Date script was run. |
| Script start time: | Time script was started. |
| Script subject ID: | Subject ID number. |
| Script group ID: | Group ID number. |
| Script elapsed time: | Time it took to run script (in ms). |
| Computer platform: | The platform the script was run on. |
| Completed: | **0** = script was not completed (prematurely aborted). |
| | **1** = script was completed (all conditions run). |
| Proportion correct: | Overall proportion correct of all trials. |
| Mean RT: | Overall mean latency (in ms) of all correct trials. |
| Mean RT Correct Congruent: | Mean latency of all correct congruent trials (in ms). |
| Mean RT Correct Incongruent: | Mean latency of all incorrect congruent trials (in ms). |
| Mean RT Correct Control: | Mean latency of all correct control trials (in ms). |
| Proportion Correct Congruent: | Proportion correct of congruent trials. |
| Proportion Correct Incongruent: | Proportion correct of incongruent trials. |
| Proportion Correct Control: | Proportion correct of control trials. |

**Appendix K: Schutte self-report Emotional Intelligence test**

## Schutte Self-Report Emotional Intelligence Test

**Directions:** Each of the following items asks you about your emotions or reactions associated with emotions. After deciding whether a statement is generally true for you, use the 5-point scale to respond to the statement. Please circle the "1" if you strongly disagree that this is like you, the "2" if you somewhat disagree that this is like you, "3" if you neither agree nor disagree that this is like you, the "4" if you somewhat agree that this is like you, and the "5" if you strongly agree that this is like you.

There are no right or wrong answers. Please give the response that best describes you.

1 = strongly disagree
2 = somewhat disagree
3 = neither agree nor disagree
4 = somewhat agree
5 = strongly agree

| | | |
|---|---|---|
| 1. | I know when to speak about my personal problems to others. | 1 2 3 4 5 |
| 2. | When I am faced with obstacles, I remember times I faced similar obstacles and overcame them. | 1 2 3 4 5 |
| 3. | I expect that I will do well on most things I try. | 1 2 3 4 5 |
| 4. | Other people find it easy to confide in me. | 1 2 3 4 5 |
| 5. | I find it hard to understand the non-verbal messages of other people. | 1 2 3 4 5 |
| 6. | Some of the major events of my life have led me to re-evaluate what is important and not important. | 1 2 3 4 5 |
| 7. | When my mood changes, I see new possibilities. | 1 2 3 4 5 |
| 8. | Emotions are one of the things that make my life worth living. | 1 2 3 4 5 |

| | | |
|---|---|---|
| 9. | I am aware of my emotions as I experience them. | 1 2 3 4 5 |
| 10. | I expect good things to happen. | 1 2 3 4 5 |
| 11. | I like to share my emotions with others. | 1 2 3 4 5 |
| 12. | When I experience a positive emotion, I know how to make it last. | 1 2 3 4 5 |
| 13. | I arrange events others enjoy. | 1 2 3 4 5 |
| 14. | I seek out activities that make me happy. | 1 2 3 4 5 |
| 15. | I am aware of the non-verbal messages I send to others. | 1 2 3 4 5 |
| 16. | I present myself in a way that makes a good impression on others. | 1 2 3 4 5 |
| 17. | When I am in a positive mood, solving problems is easy for me. | 1 2 3 4 5 |
| 18. | By looking at their facial expressions, I recognize the emotions people are experiencing. | 1 2 3 4 5 |
| 19. | I know why my emotions change. | 1 2 3 4 5 |
| 20. | When I am in a positive mood, I am able to come up with new ideas. | 1 2 3 4 5 |
| 21. | I have control over my emotions. | 1 2 3 4 5 |
| 22. | I easily recognize my emotions as I experience them. | 1 2 3 4 5 |
| 23. | I motivate myself by imagining a good outcome to tasks I take on. | 1 2 3 4 5 |
| 24. | I compliment others when they have done something well. | 1 2 3 4 5 |
| 25. | I am aware of the non-verbal messages other people send. | 1 2 3 4 5 |
| 26. | When another person tells me about an important event in his or her life, I almost feel as though I experienced this event myself. | 1 2 3 4 5 |

| | | |
|---|---|---|
| 27. | When I feel a change in emotions, I tend to come up with new ideas. | 1 2 3 4 5 |
| 28. | When I am faced with a challenge, I give up because I believe I will fail. | 1 2 3 4 5 |
| 29. | I know what other people are feeling just by looking at them. | 1 2 3 4 5 |
| 30. | I help other people feel better when they are down. | 1 2 3 4 5 |
| 31. | I use good moods to help myself keep trying in the face of obstacles. | 1 2 3 4 5 |
| 32. | I can tell how people are feeling by listening to the tone of their voice. | 1 2 3 4 5 |
| 33. | It is difficult for me to understand why people feel the way they do. | 1 2 3 4 5 |

**Appendix L: Participant information sheet**

**Participant Information Sheet**

Hello

My name is Maham Hasan, and I am a student at the University of Witwatersrand (Wits). I would like to **invite you to participate in my research project** that I am doing at your school/facility. This research project is part of my Masters degree at Wits.

This project is trying to look at what skills you use in planning and decision-making and if these skills change as you grow older. I am also trying to see how the skills you use differ from the young boys who have been caught for committing a crime. To join the project, you need to be a young boy between the ages of 14 and 16 who can understand English.

Participation in this project will involve filling in a form including some personal details. After that you will complete a few exercises on the computer. The computer exercises will be things like sorting cards, a problem-solving game, and a few other activities that test for your skills. There will also be another short survey to fill on the computer that will ask a few short questions.
Both question forms and activities will be in English. If you are worried about how to use a computer, then the question forms will be printed for you. I will also help you get used to the computer for the exercises by helping you understand how to use the computer during the exercise practice run. Participation should take about 45 minutes to 1 hour, but the time depends on you and how fast you work.

To make sure you understand everything, I will read through this sheet with you again on the day you are participating and will allow time for any questions you may have about the project and what I am asking you to do.

It is important that you know that **your participation is completely voluntary**. This means that you may choose if you want to be a part of this research or not, and you can leave the research at any time. There is no punishment if you choose to leave the project or to not answer any questions It is also important for you to know that you will not get any extra marks or credit by joining the project.

Please know that any answers and information I get from your participation will be completely secret (confidential). Your information and results will also be anonymous. This means that no one will your name or where you come from in the research report and no one will have access to your results other than myself. To keep your information secret from the public, I will assign you a number, your Person

ID. You will need to use this Person ID on all your documents and tests. I will also not ask for any other identifying information such as your house address. To keep your information private, the information you give to me will be held safely on my computer and only I will be able to see your answers. Since the research is looking at the patterns rising from the results of a lot of individuals, my reporting of the results will not be pointing out at you or any other individual in a way that can name them. You You have the choice not to answer questions that make you uncomfortable, and you may choose to leave the study at any point.

Please note that although I am studying psychology and this project is looking at the skills you use to make decisions; this study and the results are ***not*** here to diagnose you. This means that I cannot give you feedback on your results of the tests. However, a one-page summary of the ***overall*** research results can be sent to you if you ask me for it.

If you have any questions afterwards about this research, feel free to contact me on **94.maham@gmail.com**. For any questions, concerns or complaints regarding the ethical procedures of this study, you are welcome to contact the University Human Research Ethics Committee (non-medical), by telephone on **(011) 717 1408**; or via email on **hrec-medical.researchoffice@wits.ac.za** or **Shaun.Schoeman@wits.ac.za.**

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*Note: The interview questions and research process attempt to present little risk or harm to you as a participant. If at any point you feel sad or troubled after the test and wish to talk to a counsellor, please contact your school counsellor or phone **SADAG** on **0800 12 13 14**; or **Lifeline** on **0861 322 322**. These abovementioned organisations offer **free** telephone counselling services.*

---

Thank you.


Ms Maham Hasan

MA Social and Psychological Research (Wits)
Student: University of the Witwatersrand
Cell: 0828359405
e-mail: 94.maham@gmail.com

Ms Enid Schutte

M.Ed. (Wits)
Lecturer: University of the Witwatersrand
Office: (011)7174521
Cell: 0829206731
e-mail: enid.schutte@wits.ac.za

**Appendix M: Parent/Guardian information sheet**

**Parent/Guardian Information Sheet**

Dear Parent/Legal Guardian

My name is Maham Hasan. I am a student at the University of Witwatersrand. I would like to **ask for your consent** to allow the young man under your care to **participate in a research project** I am conducting at his school. The research project is part of my Master's degree at Wits.

This project is trying to look at what skills your son uses to plan and make decisions, and if these skills change as he grows older. I am also trying to see to what extent the skills he uses are different from the young boys who have been convicted for committing a crime. I will need your consent allowing your son to join the project. To participate, your son needs to be a young boy between the ages of 14 and 16, who can understand English.

Your son's participation in this project will involve him filling in a form including some personal details. Please know that his identity and address will not be asked in those details. After that, he will complete a few exercises on the computer. The computer-based exercises will ask him to sort cards; do some problem-solving exercises, and a few other activities that test for his skills. There will also be a computer-based short questionnaire that will be completed.
The question forms and activities will be in English. I will help your son for the computer exercises by helping him understand how to use the computer during the practice run. His participation should take about 45 minutes to 1 hour, but the time depends on him and how fast he works.

It is important that you know that **your child's participation is completely voluntary**. This means that you may choose if you want him to be a part of this research or not, and he can leave the research at any time if he does choose to participate. There is no punishment if he chooses to leave the project or to not answer any questions It is also important for you to know that your son will not get any extra marks or credit by joining the project.

Please know that any individual answers and information I get from his participation will be kept secret (confidential). Additionally, his results from the participation will be written while keeping his identity unknown to the public. This means that anyone who reads the research report will know his name or where he lives and they will not be able to identify him. Additionally, no one will have access to his results other than myself. To keep all information secret from the public, I will assign your son a number, called a Person ID. He will be using this Person ID on all his documents and tests. I will also not ask for any other identifying information such as your house address. To keep all information private, the information you or your son give to me will be held safely on my computer and only I will

be able to see the answers. Since the research is looking at the patterns rising from the results of a lot of individuals, my reporting of the results will not be pointing out at your son or any other individual in a way that can name them.

Please note that although I am studying psychology and this project is looking at the skills you use to make decisions; this study and the results are ***not*** here to diagnose you. This means that I cannot give you feedback on your results of the tests. However, a one-page summary of the ***overall*** research results can be sent to you if you ask me for it.

If you have any questions afterwards about this research, feel free to contact me on **94.maham@gmail.com**. For any queries, concerns or complaints regarding the ethical procedures of this study, you are welcome to contact the University Human Research Ethics Committee (non-medical), by telephone on **(011) 717 1408**; or via email on **hrec-medical.researchoffice@wits.ac.za** or **Shaun.Schoeman@wits.ac.za.**

---

*Note: The interview questions and research process attempt to present little risk or harm to your son/ward as a participant. If at any point you feel that he is sad or troubled after the test please ask him to talk to someone. If he wants to speak to a counsellor, he can phone **SADAG** on **0800 12 13 14**; or **Lifeline** on **0861 322 322**. These organisations offer **free** telephone counselling services and can be helpful to your son.*

---

Thank you for your time.

Kind Regards


Ms Maham Hasan

MA Social and Psychological Research (Wits)
Student: University of the Witwatersrand
Cell: 0828359405
e-mail: 94.maham@gmail.com

Ms Enid Schutte

M.Ed. (Wits)
Lecturer: University of the Witwatersrand
Office: (011)7174521
Cell: 0829206731
e-mail: enid.schutte@wits.ac.za

**Appendix N: Participant assent form**


**Participant Assent Form**

I, _____, agree that I have read an understood the research Information Sheet and the following points about the research conducted by Ms Maham Hasan.

- I understand that my participation in this research is ***my choice*** and that I can leave this project at any time I like.
- I understand that I may stop answering questions if I become uncomfortable and I will not be forced to complete the participation.
- I understand that I will receive no direct benefits from the research. So, I will not receive money or class credit or marks for taking part in this research.
- I understand that all the information collected will be treated with utmost care to make sure that no one else gets access to my test results and that my name and identity will remain secret.
- I understand that the tests are not used to diagnose me, and the researcher cannot diagnose me with any learning disability.
- I understand that my results will be used to create a research report/summary that will be published on the university library site.
- I understand that I have access to the published results, should I wish it.
- I know and understand that I may contact the researcher at any point to ask questions about the research.
- I agree that the researcher has answered all my questions regarding my research.
- I agree that the researcher has given me emergency counselling contact details, in case I feel uncomfortable by the research process.
- Lastly, I understand that by signing this form I agree that ***I give the researcher permission to publish*** the research report with my results, as long as my name remains a secret.

Date: _____ Signature: _____

**Appendix O: Parent/Guardian consent form**

**Parent/ Guardian Consent Form**

I, _____, parent/guardian of _____, agree that I have read an understood the research Information Sheet and the following points about the research conducted by Ms Maham Hasan.

- I understand that participation in this research is ***by choice*** and that my son/ ward may leave at his own will at any time in the research. I also understand that my son/ward is not allowed to take part in this research without my permission.
- I understand that my son/ ward has the right to stop responding if he becomes uncomfortable and he will not be forced to complete his participation for the project.
- I understand that neither I, nor my son/ward will receive direct benefits from the research.
- My child can phone SADAG or Lifeline if anything has upset him/her or if he/she feels she needs to talk to someone.
- I understand that the researchers will not use my child's name or any other identifying information (such as the place where we live) in any reports that use information gathered from this interview. I understand that my child's confidentiality as a participant in this study will remain secure. This means that the information will be kept private.
- I understand that the tests are not used for diagnostic purposes and the researcher cannot diagnose my son/ ward with any learning disability. I also understand that my child will not be judged because of the results to the computer-based tests.
- I understand that the results will be used to create a research report/summary that will be published on the university library site.
- I understand that I have access to the published results, should I ask for it.
- I know and understand that I may contact the researcher at any point to ask questions about the research.
- I agree that the researcher has answered all my questions about the research process.

- I understand that by signing this consent form, I agree to give the researcher permission to publish the research containing my son/ward's results, as long as his identity remains a secret.

Date: _____ Signature: _____

## Appendix P: Permission from Counselling Centers

LifeLine
Building Community Heart


LifeLine Pretoria
71Watermeyer Street
Val de Grace, 0184
P O BOX 12407
Queenswood
0121
Office Tel: 012 804 1853
Crisis Line: 012 804 3619
Rape Crisis Line 082 340 2061
email: reception.lifeline.pta@gmail.com
www.lifelinepta.org.za


N.P.O. no.: 001-592 NPO
P.B.O Number 930031148
Section 18A Reference Number: 9442/794/12/3
B-BBBEE: Level 2

August 2018

Dear Maham Hasan

**Re: Request for LifeLine Pretoria to render services to your clients**

Thank you for contacting Life Line Pretoria in this regard, our services are available to anyone in need of Free counselling and you are most welcome to refer any of your participants to us. We usually work with 16 – 18 years and upwards.

Our counselling is Carl Rogers person centred approach we deal with the emotions and refer when it is beyond our scope of practice

Warm regards

Sonya Rayne
Director LifeLine Pretoria
076 516 8824
Tel: 012 804 1853 | Fax: 012 804 7039
Crisis: 012 804 3619 |
Rape Counselling line - 082 340 2061
http://lifelinepta.org.za

http://www.facebook.com/lifeline.pretoria;

LifeLine Pretoria 2018: Directior S. Rayne Chairperson: S Houghton

**Appendix Q: Permission Letter from GDSD**

GAUTENG PROVINCE
SOCIAL DEVELOPMENT
REPUBLIC OF SOUTH AFRICA

Enquiries: Dr. Sello Mokoena
Tel: (011) 3557947
File no.: 2/9/06

**MS MAHAM HASAN**

Dear Ms Maham Hasan

**RE: APPLICATION TO CONDUCT RESEARCH IN THE GAUTENG DEPARTMENT OF SOCIAL DEVELOPMENT**

Thank you for your application to conduct research within the Gauteng Department of Social Development.

Your application on the research on "**Exploring Criminal Capacity in Terms of Executive Function: An Investigation within the South African Youth Male Population of Gauteng**" has been considered and approved for support by the Department as it was found to be beneficial to the Department's vision and mission. The approval is subject to the Department's terms and conditions as endorsed on the 27th of July 2018. In order for the department to learn and draw from the findings and recommendations of your study, please note that you are requested to provide the department with a copy of your dissertation/thesis once your study has been completed.

May I take this opportunity to wish you well on the journey you are about to embark on.

We look forward to a value adding research and a fruitful co-operation.

With thanks

**Ms A HARTMANN**
**Deputy Director General: Support Services**
**Date:** 31/8/2018

**Appendix R: GDE Approval for 2019**

GAUTENG PROVINCE
Department: Education
REPUBLIC OF SOUTH AFRICA

8/4/4/1/2

## GDE AMENDED RESEARCH APPROVAL LETTER

| | |
|---|---|
| **Date:** | **09 September 2018** |
| **Validity of Research Approval:** | **11 February 2019 – 30 September 2019**<br>**2018/272A** |
| **Name of Researcher:** | **Hasan M.** |
| **Address of Researcher:** | **PO Box 41490** |
| | **Reyno Ridge** |
| | **Witbank, 1049** |
| **Telephone Number:** | **082 835 9405** |
| **Email address:** | **94.maham@gmail.com** |
| **Research Topic:** | **Exploring criminal capacity in terms of executive control function: An investigation within the South African Youth Male population of Gauteng** |
| **Type of qualification** | **MA Social and Psychology Research** |
| **Number and type of schools:** | **Three Secondary Schools, One ELSEN School** |
| **District/s/HO** | **Johannesburg Central, Johannesburg North, Tshwane North, Tshwane South.** |

***Re: Approval in Respect of Request to Conduct Research***

This letter serves to indicate that approval is hereby granted to the above-mentioned researcher to proceed with research in respect of the study indicated above. The onus rests with the researcher to negotiate appropriate and relevant time schedules with the school/s and/or offices involved to conduct the research. A separate copy of this letter must be presented to both the School (both Principal and SGB) and the District/Head Office Senior Manager confirming that permission has been granted for the research to be conducted.

09/10/2018

**The following conditions apply to GDE research. The researcher may proceed with the above study subject to the conditions listed below being met. Approval may be withdrawn should any of the conditions listed below be flouted:**





**Office of the Director: Education Research and Knowledge Management**
7th Floor, 17 Simmonds Street, Johannesburg, 2001
Tel: (011) 355 0488
Email: Faith.Tshabalala@gauteng.gov.za
Website: www.education.gpg.gov.za

1. *The District/Head Office Senior Manager/s concerned must be presented with a copy of this letter that would indicate that the said researcher/s has/have been granted permission from the Gauteng Department of Education to conduct the research study.*
2. *The District/Head Office Senior Manager/s must be approached separately, and in writing, for permission to involve District/Head Office Officials in the project.*
3. *A copy of this letter must be forwarded to the school principal and the chairperson of the School Governing Body (SGB) that would indicate that the researcher/s have been granted permission from the Gauteng Department of Education to conduct the research study.*
4. *A letter / document that outline the purpose of the research and the anticipated outcomes of such research must be made available to the principals, SGBs and District/Head Office Senior Managers of the schools and districts/offices concerned, respectively.*
5. *The Researcher will make every effort obtain the goodwill and co-operation of all the GDE officials, principals, and chairpersons of the SGBs, teachers and learners involved. Persons who offer their co-operation will not receive additional remuneration from the Department while those that opt not to participate will not be penalised in any way.*
6. *Research may only be conducted after school hours so that the normal school programme is not interrupted. The Principal (if at a school) and/or Director (if at a district/head office) must be consulted about an appropriate time when the researcher/s may carry out their research at the sites that they manage.*
7. *Research may only commence from the second week of February and must be concluded before the beginning of the last quarter of the academic year. If incomplete, an amended Research Approval letter may be requested to conduct research in the following year.*
8. *Items 6 and 7 will not apply to any research effort being undertaken on behalf of the GDE. Such research will have been commissioned and be paid for by the Gauteng Department of Education.*
9. *It is the researcher's responsibility to obtain written parental consent of all learners that are expected to participate in the study.*
10. *The researcher is responsible for supplying and utilising his/her own research resources, such as stationery, photocopies, transport, faxes and telephones and should not depend on the goodwill of the institutions and/or the offices visited for supplying such resources.*
11. *The names of the GDE officials, schools, principals, parents, teachers and learners that participate in the study may not appear in the research report without the written consent of each of these individuals and/or organisations.*
12. *On completion of the study the researcher/s must supply the Director: Knowledge Management & Research with one Hard Cover bound and an electronic copy of the research.*
13. *The researcher may be expected to provide short presentations on the purpose, findings and recommendations of his/her research to both GDE officials and the schools concerned.*
14. *Should the researcher have been involved with research at a school and/or a district/head office level, the Director concerned must also be supplied with a brief summary of the purpose, findings and recommendations of the research study.*

The Gauteng Department of Education wishes you well in this important undertaking and looks forward to examining the findings of your research study.

Kind regards

.....

Mrs Faith Tshabalala
Acting Director: Education Research and Knowledge Management

DATE: 09/10/2018

**Appendix S: Email correspondence re researcher's safety**

From: Xolani Mpelane <Xolani.Mpelane@gauteng.gov.za>

Sent: Monday, 07 May 2018 6:16 PM

To: Maham Hasan

Cc: Pearl Moabelo; Awelani Madira; Veronica Sihawu

Subject: RE: Enquiry on personal safety

Hi Hasan

I am delighted indeed to know the progress and I am very much happy for you. May I propose that you engage Judith on all the matters related to your studies moving forward.

I think our centres are very safe for anyone who visit those. However, safety in any area is never 100% guaranteed because unforeseen circumstances do happen. I can assure you we have never had incidents where a visitor has ever been hurt, injured or even lost his or her belongings because visitors are told of the safety measures upon visit.

I hope that alleviate your fears and that of your board.

Regards

**Appendix T: Johannesburg Central Education District Approval**

GAUTENG PROVINCE
EDUCATION
REPUBLIC OF SOUTH AFRICA

Enquiries: Caroline Tladi
File no: 3/2/1
Tele: 011 983 2135
Email: Caroline.Tladi@gauteng.gov.za
Chief Directorate: Education Planning and Research

**MS M. HASAN**
**MASTERS IN SOCIAL AND PSYCHOLOGICAL RESEARCH**
**UNIVERSITY OF THE WITWATERSRAND**
**REYNO RIDGE**
**WITBANK**
**1049**

By Email: 94.maham@gmail.com

Dear Ms M. Hasan

**SUBJECT: RESEARCH APPROVAL LETTER**

Correspondence received from you on 04 September 2018 titled: *Exploring criminal capacity in terms of executive control function: An investigation within South African Youth Male population of Gauteng,* is acknowledged and has reference.

Thank you for informing the District Office of your intended research.
The following attachments are acknowledged and received:

1. GDE Research Approval letter from the Knowledge Management and Research Directorate at GDE Head Office – 31 August 2018.
2. Research Proposal
3. Letter to the District Director
4. Participation Information Sheet
5. School/Facility Information Sheet

You are welcome to proceed with your research however, in the execution thereof; you are reminded to heed the President's non-negotiable and be mindful of protecting contact time.

The District Office wishes you great success with your research and reminds you to comply with the terms and conditions against which approval has been granted by the Knowledge Management and Research Directorate.

Yours sincerely

Acting
**MS B. L. T. SEATE**
**DISTRICT DIRECTOR**
**DATE: 05 SEPTEMBER 2018**

Tel: (011) 355 0000
17 Simmonds Street, Johannesburg, 2001 | P.O. Box 7710, Johannesburg, 2000
www.gautengonline.gov.za | Hotline: 08600 11 000

## Appendix U: Email regarding Permission from Walter Sisulu Secure Care Center

**From:** Tsakani Maluleke
**Sent:** Friday, September 14, 2018 2:03 PM
**To:** Maham Hasan <94.maham@gmail.com>; Nonhlanhla N. Ndimande <Nonhlanhla.Ndimande@gauteng.gov.za>; Douglas Mavhunga <Douglas.Mavhunga@gauteng.gov.za>
**Cc:** Ronnie Shema <Ronnie.Shema@gauteng.gov.za>; Talita T. Filmer (GPWEL) <Talita.Filmer@gauteng.gov.za>
**Subject:** RE: Permission to conduct research

Good day

The letter from the Head of Department should suffice, we are not authorised to write further letters

Moving forward I request that you liaise with Mr. Douglas Mavhunga at 011 983 0046, the supervisor for secure care

Douglas please assist accordingly

Thanks
Tsakani

**From:** Maham Hasan [mailto:94.maham@gmail.com]
**Sent:** Friday, 14 September 2018 11:40 AM
**To:** Tsakani Maluleke <Tsakani.Maluleke@gauteng.gov.za>
**Cc:** Ronnie Shema <Ronnie.Shema@gauteng.gov.za>; Talita T. Filmer (GPWEL) <Talita.Filmer@gauteng.gov.za>
**Subject:** Fwd: Permission to conduct research

Dear Ma'am

Please note that my ethics board is requesting a formal letter from you confirming that I get permission from you to conduct my study with the convicted youth under your care.

Please note that this permission letter needs to be received by Wednesday. The letter needs to indicate the following:
1) confirming that I have permission to conduct the study.
2) indicating the school you outsource your convicted youth too (both sentenced and divergent)
3) indicating if the children have access to any psychologist or social worker should my research upset them. Please also provide name and number of the psychologist/social worker in charge.
4) please indicate that the convicted children are under your guardianship and as such you get guardian/parental rights for their care during their stay.

Thank you.

Kind Regards

Maham Hasan
0828359405

## Appendix V: BOSASA Secure Care Center Approval

BOSASA YOUTH DEVELOPMENT CENTRES (PTY) LTD
Reg No 2003/002608/07 Vat No 4610209985
SMART GLOBAL CAMPUS | 1 Windsor Road | Luipaardsvlei | Mogale City | Gauteng | South Africa
Private Bag 2002 | Krugersdorp | 1740 | Gauteng | South Africa GPS: S 26° 06.830' E 27° 46.943'
Tel: +27(0)11 662 6000 Fax: +27(0)86 515 2302 National Number: +27(0)86 181 1911
www.bosasaydc.com

Dear Mahan Hasan,

Permission is hereby granted for you to conduct your research at our Bosasa Mogale Youth Centre in Krugersdorp, after reading your research outline.
The Head of Department Gauteng, has granted her permission to undertake the research study.

In Mogale Youth Development Centre, we do have a computer centre, which is used by our young people for computer literacy training.

Ms Mahan Hasan will be permitted to use the facility; however, it must be stated that the compatibility of her programme and ours cannot be guaranteed.

Furthermore, the young people in our facility are always under the care of a Social Worker , who is the Case Manager, counselling or therapeutic intervention will be made available when required by a young person, at any stage of this research study.

Kind regards

Thandi Makoko
*Chairperson*
Youth Development Centres
Phone: +27 11 662 6891

AFRICANGLOBAL
CONNECTING AFRICA GLOBALLY

DIRECTORS: JSA Leyds (Ms), NLT Makoko (Ms), MS Diamini, LCS Scholtz (Dr), M Oliveria (Ms)

BOSASA CHILD & YOUTH CARE CENTRES:
MOGALE LESEDING +27(0)11 665 1247/660 6227 | CLANWILLIAM +27(0) 27 482 1900/02 | HORIZON +27(0)21 843 3863/4 | NAMAQUA +27(0)27 712 3496/7
DE AAR +27(0)53 631 6008/11 | BURGERSDORP +27(0)51 653 2100 | MATLOSANA +27(0)18 466 5500 | RUSTENBURG +27(0)14 597 5979/5989
POLOKWANE +27(0)15 293 1728 | MAVAMBE +27(0) 15 851 7907/11

**Appendix W: Permission Letters from Schools**

SEKONDÊRE SKOOL

MISSOURI LAAN

SECONDARY SCHOOL

AVE

U Verw.
Your Ref .....

Ons Verw.
Our Ref .....

15 Missouri Avenue
Ext 7
Eldorado Park
Private Bag x12
Kliptown, 1812
Tel: (011) 342-1107
Fax: (011) 342-1132/086 527 3779
Email: missourilaan@gmail.com

Dear Ms Maham Hasan

You are hereby granted permission to conduct your Master's Dissertation research at *Missourilaan Secondary School.*

I confirm to have received and read the appropriate documents regarding permission granted from the Gauteng Department of Education and the Johannesburg Central Education District to undertake the research study.

Our school has government sanctioned computers available in the staffroom. You are permitted to use the facilities for the duration of your stay as both the staffroom and the computers therein are generally not in use. However, I cannot confirm the compatibility of your programme to the computers.

We do have a Student-Based Support Team in our school consisting of teachers' students can reach out to during distress. Should the students wish, they can reach out to the teachers, but please be informed that they are not trained in counselling skills.
I wish you well with your research and would like to remind you to provide us with your research report at the completion of your study.

GAUTENG ONDERWYS DEPARTMENT
MISSOURI LAAN SECONDARY SCHOOL
TEL (011) 342 1107 FAX (011) 342 1132

13 FEB 2019

PRIVATE BAG X12
ELDORADO PARK KLIPTOWN 1812
GAUTENG DEPARTMENT OF EDUCATION

Kind Regards

***Principle:*** **Mr Van Rensberg**
Missourilaan Secondary School

P O Box 901008,
Bertsham, 2013 ,
Tel 010 233 0025
altmonthigh@outlook.com
South Africa

**ALTMONT TECHNICAL HIGH SCHOOL**

Cnr. Alekhine and Stanton
Road, Protea South,
Soweto
Tel:010 233 0025
Cell: 082 557 2760
South Africa

Dear Ms Maham Hasan

I hereby grant you permission to conduct your research at *Altmont Technical High School* in Soweto.

I confirm to have received and read the appropriate documents regarding permission granted from the Gauteng Department of Education and the Johannesburg Central Education District to undertake the research study.

Although Our school has limited computer facilities available for computer literacy training for our students along with laptops provided to teachers from the government, You are permitted to use the facilities and our staffroom for the duration of your stay.

I wish you well with your research and would like to remind you to kindly provide us with your research report at the completion of your study.

Kind Regards

Mrs Baloyi
Principal
Altmont Technical High school

GAUTENG DEPARTMENT OF EDUCATION
ALTMONT TECHNICAL HIGH SCHOOL
Tel 010 233 0025
2019 -02- 15
249/3675 CNR ALEKHINE & STANTON ROAD
PROTEA SOUTH, SOWETO
PO BOX 901008 BERTSHAM 2013

**Principal:** Mrs. A.M. Baloyi, **(Deputy)** Mr. M.S. Duma **(Acting Deputy)** Ms. Maloma, M.E
**(SGB Chairperson)** Mr. D. Baloyi, **(SGB Deputy Chairperson)** Ms.M .H. Khamedi, **(SGB Treasurer)** Ms. B.E. Mthethwa, **(SGB Secretary)** Ms. G Malematja
ZIMISELE

## Appendix X: Additional Statistical Tables and Graphs from Results Section

**Table 5.3.2.3.**

*Reliability Scores of the Scale Items*

| Responses | Scale Mean if Item Deleted | Scale Variance if Item Deleted | Corrected Item-Total Correlation | Cronbach's Alpha if Item Deleted |
|---|---|---|---|---|
| q1_response | 120.40 | 209.242 | .388 | .860 |
| q2_response | 120.20 | 211.815 | .372 | .860 |
| q3_response | 119.84 | 209.175 | .461 | .858 |
| q4_response | 120.73 | 213.486 | .275 | .862 |
| q5R_response | 121.16 | 222.252 | -.015 | .869 |
| q6_response | 120.11 | 204.333 | .534 | .856 |
| q7_response | 120.30 | 207.056 | .467 | .858 |
| q8_response | 120.35 | 213.615 | .238 | .864 |
| q9_response | 119.96 | 208.633 | .511 | .857 |
| q10_response | 119.77 | 209.120 | .457 | .858 |
| q11_response | 121.01 | 210.394 | .278 | .863 |
| q12_response | 120.16 | 207.464 | .477 | .858 |
| q13_response | 120.57 | 210.151 | .391 | .860 |
| q14_response | 120.00 | 214.442 | .247 | .863 |
| q15_response | 120.51 | 210.829 | .314 | .862 |
| q16_response | 119.91 | 209.291 | .435 | .859 |
| q17_response | 119.80 | 205.777 | .555 | .856 |
| q18_response | 120.34 | 212.054 | .304 | .862 |
| q19_response | 120.28 | 207.548 | .429 | .859 |
| q20_response | 119.80 | 209.469 | .563 | .857 |
| q21_response | 120.30 | 205.152 | .495 | .857 |
| q22_response | 120.06 | 209.747 | .487 | .858 |
| q23_response | 119.97 | 212.605 | .364 | .860 |
| q24_response | 119.88 | 207.975 | .533 | .857 |
| q25_response | 120.44 | 207.479 | .456 | .858 |
| q26_response | 120.18 | 208.592 | .418 | .859 |
| q27_response | 120.35 | 210.153 | .376 | .860 |

| | | | | |
|---|---|---|---|---|
| q28R_response | 120.00 | 214.577 | .195 | .865 |
| q29_response | 120.48 | 212.386 | .278 | .863 |
| q30_response | 120.04 | 208.518 | .508 | .857 |
| q31_response | 120.02 | 209.807 | .477 | .858 |
| q32_response | 120.22 | 208.211 | .442 | .858 |
| q33R_response | 121.47 | 223.655 | -.062 | **.872** |

**Table 5.3.4.3**

*Average SSEIT Scores Per Question*

| **Responses** | **YSCC Sample** | | **School Sample** | |
|---|---|---|---|---|
| | **Mean** | **Std. Deviation** | **Mean** | **Std. Deviation** |
| q1_response | 3,38 | 1,168 | 3,78 | 1,039 |
| q2_response | 3,74 | 0,939 | 3,87 | 0,942 |
| q3_response | **3,88** | 1,109 | **4,38** | 0,792 |
| q4_response | 3,21 | 1,025 | 3,33 | 1,047 |
| q5R_response | 2,74 | 1,106 | 2,94 | 0,982 |
| q6_response | 3,86 | 1,095 | 3,94 | 1,162 |
| q7_response | 3,76 | 0,906 | 3,70 | 1,200 |
| q8_response | 3,69 | 1,093 | 3,65 | 1,180 |
| q9_response | 3,98 | 0,924 | 4,11 | 0,900 |
| q10_response | 4,07 | 0,997 | 4,37 | 0,938 |
| q11_response | 2,98 | 1,423 | 3,03 | 1,270 |
| q12_response | 3,93 | 1,068 | 3,81 | 1,030 |
| q13_response | 3,43 | 1,016 | 3,46 | 1,045 |
| q14_response | 3,88 | 1,109 | 4,11 | 0,952 |
| q15_response | 3,50 | 1,153 | 3,51 | 1,190 |
| q16_response | **3,67** | 1,183 | **4,40** | 0,730 |
| q17_response | 3,98 | 1,179 | 4,38 | 0,851 |
| q18_response | 3,60 | 1,037 | 3,73 | 1,125 |
| q19_response | **3,45** | 1,194 | **3,94** | 1,061 |
| q20_response | 4,05 | 0,795 | 4,33 | 0,762 |
| q21_response | 3,67 | 1,052 | 3,76 | 1,228 |
| q22_response | 3,86 | 0,843 | 4,03 | 0,897 |
| q23_response | **3,74** | 0,989 | **4,25** | 0,761 |
| q24_response | 3,98 | 1,000 | 4,25 | 0,842 |
| q25_response | 3,40 | 1,191 | 3,70 | 0,994 |
| q26_response | 3,79 | 1,159 | 3,87 | 1,039 |
| q27_response | 3,62 | 1,081 | 3,70 | 1,057 |
| q28R_response | **3,38** | 1,287 | **4,44** | 0,929 |

| | | | | |
|---|---|---|---|---|
| q29_response | 3,43 | 1,172 | 3,62 | 1,113 |
| q30_response | 3,79 | 1,001 | 4,11 | 0,845 |
| q31_response | **3,81** | 0,943 | **4,13** | 0,833 |
| q32_response | 3,71 | 0,944 | 3,86 | 1,134 |
| q33R_response | 2,48 | 1,311 | 2,60 | 1,100 |

**Table 5.3.5.4**

*Independent Samples T-test results for all SSEIT Items*

| | | Levene's Test | | t-test for Equality of Means | | | | |
|---|---|---|---|---|---|---|---|---|
| | | **F** | **Sig.** | **t** | **df** | **Sig. (2-tailed)** | **Mean Difference** | **Std. Error Difference** |
| Q1 | Equal variances assumed | 3,039 | 0,084 | -1,663 | 102 | 0,099 | -0,363 | 0,218 |
| | Equal variances not assumed | | | -1,624 | 78,721 | 0,108 | -0,363 | 0,224 |
| Q2 | Equal variances assumed | 0,479 | 0,491 | -0,745 | 102 | 0,458 | -0,141 | 0,190 |
| | Equal variances not assumed | | | -0,744 | 85,116 | 0,459 | -0,141 | 0,190 |
| Q3 | Equal variances assumed | 1,248 | 0,267 | -2,470 | 102 | **0,015** | -0,454 | 0,184 |
| | Equal variances not assumed | | | -2,315 | 67,471 | 0,024 | -0,454 | 0,196 |
| Q4 | Equal variances assumed | 0,069 | 0,793 | -0,430 | 102 | 0,668 | -0,089 | 0,208 |
| | Equal variances not assumed | | | -0,433 | 87,265 | 0,666 | -0,089 | 0,207 |
| Q5_R | Equal variances assumed | 0,388 | 0,535 | -1,248 | 102 | 0,215 | -0,254 | 0,203 |
| | Equal variances not assumed | | | -1,228 | 80,906 | 0,223 | -0,254 | 0,207 |
| Q6 | Equal variances assumed | 0,984 | 0,324 | -0,044 | 102 | 0,965 | -0,010 | 0,222 |
| | Equal variances not assumed | | | -0,045 | 93,750 | 0,964 | -0,010 | 0,215 |
| Q7 | Equal variances assumed | 5,450 | **0,022** | 0,490 | 102 | 0,625 | 0,106 | 0,217 |
| | Equal variances not assumed | | | 0,523 | 100,676 | 0,602 | 0,106 | 0,204 |
| Q8 | Equal variances assumed | 0,673 | 0,414 | 0,354 | 102 | 0,724 | 0,081 | 0,229 |
| | Equal variances not assumed | | | 0,361 | 91,267 | 0,719 | 0,081 | 0,224 |
| Q9 | Equal variances assumed | 0,525 | 0,470 | -0,484 | 102 | 0,629 | -0,087 | 0,179 |
| | Equal variances not assumed | | | -0,487 | 86,989 | 0,628 | -0,087 | 0,178 |
| Q10 | Equal variances assumed | 1,313 | 0,255 | -1,283 | 102 | 0,202 | -0,243 | 0,190 |
| | Equal variances not assumed | | | -1,278 | 84,611 | 0,205 | -0,243 | 0,190 |
| Q11 | Equal variances assumed | 1,004 | 0,319 | -0,118 | 102 | 0,906 | -0,032 | 0,268 |
| | Equal variances not assumed | | | -0,115 | 78,200 | 0,908 | -0,032 | 0,275 |
| Q12 | Equal variances assumed | 1,610 | 0,207 | 0,941 | 102 | 0,349 | 0,190 | 0,202 |
| | Equal variances not assumed | | | 0,952 | 88,928 | 0,343 | 0,190 | 0,200 |
| Q13 | Equal variances assumed | 0,417 | 0,520 | 0,015 | 102 | 0,988 | 0,003 | 0,206 |
| | Equal variances not assumed | | | 0,015 | 88,118 | 0,988 | 0,003 | 0,205 |
| Q14 | Equal variances assumed | 0,052 | 0,819 | -1,263 | 102 | 0,210 | -0,257 | 0,204 |
| | Equal variances not assumed | | | -1,223 | 76,312 | 0,225 | -0,257 | 0,211 |
| Q15 | Equal variances assumed | 1,317 | 0,254 | 0,229 | 102 | 0,819 | 0,053 | 0,232 |
| | Equal variances not assumed | | | 0,233 | 90,493 | 0,816 | 0,053 | 0,228 |
| | Equal variances assumed | 7,517 | **0,007** | -3,709 | 102 | **0,000** | -0,690 | 0,186 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Q16 | Equal variances not assumed | | | -3,377 | 60,457 | 0,001 | -0,690 | 0,204 |
| Q17 | Equal variances assumed | 0,469 | 0,495 | -1,736 | 102 | 0,086 | -0,332 | 0,191 |
| | Equal variances not assumed | | | -1,647 | 70,597 | 0,104 | -0,332 | 0,202 |
| Q18 | Equal variances assumed | 0,153 | 0,696 | -0,776 | 102 | 0,440 | -0,169 | 0,218 |
| | Equal variances not assumed | | | -0,791 | 91,087 | 0,431 | -0,169 | 0,214 |
| Q19 | Equal variances assumed | 2,643 | 0,107 | -2,012 | 102 | **0,047** | -0,449 | 0,223 |
| | Equal variances not assumed | | | -1,965 | 78,727 | 0,053 | -0,449 | 0,228 |
| Q20 | Equal variances assumed | 1,388 | 0,242 | -1,563 | 102 | 0,121 | -0,236 | 0,151 |
| | Equal variances not assumed | | | -1,576 | 87,810 | 0,119 | -0,236 | 0,150 |
| Q21 | Equal variances assumed | 1,193 | 0,277 | -0,236 | 102 | 0,814 | -0,055 | 0,232 |
| | Equal variances not assumed | | | -0,245 | 95,460 | 0,807 | -0,055 | 0,223 |
| Q22 | Equal variances assumed | 0,035 | 0,852 | -1,156 | 102 | 0,250 | -0,202 | 0,175 |
| | Equal variances not assumed | | | -1,174 | 90,039 | 0,243 | -0,202 | 0,172 |
| Q23 | Equal variances assumed | 0,396 | 0,531 | -2,790 | 102 | **0,006** | -0,473 | 0,170 |
| | Equal variances not assumed | | | -2,656 | 71,576 | 0,010 | -0,473 | 0,178 |
| Q24 | Equal variances assumed | 0,049 | 0,825 | -1,285 | 102 | 0,202 | -0,230 | 0,179 |
| | Equal variances not assumed | | | -1,249 | 77,434 | 0,215 | -0,230 | 0,184 |
| Q25 | Equal variances assumed | 4,168 | **0,044** | -1,205 | 102 | 0,231 | -0,259 | 0,215 |
| | Equal variances not assumed | | | -1,161 | 74,932 | 0,249 | -0,259 | 0,223 |
| Q26 | Equal variances assumed | 0,096 | 0,758 | -0,091 | 102 | 0,928 | -0,019 | 0,212 |
| | Equal variances not assumed | | | -0,090 | 82,936 | 0,928 | -0,019 | 0,214 |
| Q27 | Equal variances assumed | 0,039 | 0,843 | -0,188 | 102 | 0,852 | -0,040 | 0,213 |
| | Equal variances not assumed | | | -0,187 | 85,249 | 0,852 | -0,040 | 0,213 |
| Q28_R | Equal variances assumed | 9,702 | **0,002** | -5,094 | 102 | **0,000** | -1,103 | 0,217 |
| | Equal variances not assumed | | | -4,770 | 67,185 | 0,000 | -1,103 | 0,231 |
| Q29 | Equal variances assumed | 0,036 | 0,851 | -0,684 | 102 | 0,495 | -0,156 | 0,227 |
| | Equal variances not assumed | | | -0,678 | 82,863 | 0,500 | -0,156 | 0,230 |
| Q30 | Equal variances assumed | 0,112 | 0,739 | -1,566 | 102 | 0,120 | -0,282 | 0,180 |
| | Equal variances not assumed | | | -1,520 | 76,963 | 0,133 | -0,282 | 0,185 |
| Q31 | Equal variances assumed | 0,005 | 0,941 | -1,577 | 102 | 0,118 | -0,273 | 0,173 |
| | Equal variances not assumed | | | -1,547 | 80,120 | 0,126 | -0,273 | 0,177 |
| Q32 | Equal variances assumed | 2,326 | 0,130 | -0,370 | 102 | 0,712 | -0,077 | 0,207 |
| | Equal variances not assumed | | | -0,393 | 99,812 | 0,695 | -0,077 | 0,195 |
| Q33_R | Equal variances assumed | 0,282 | 0,597 | -0,805 | 102 | 0,423 | -0,189 | 0,234 |
| | Equal variances not assumed | | | -0,781 | 77,072 | 0,437 | -0,189 | 0,241 |

**Table 5.3.6.1**

*Observed Power of Between Group Scores of the SSEIT*

**Tests of Between-Subjects Effects**

Dependent Variable: expressions,totalscore

| Source | Type III Sum of Squares | df | Mean Square | F | Sig. | Partial Eta Squared | Noncent. Parameter | Observed Power[b] |
|---|---|---|---|---|---|---|---|---|
| Corrected Model | 843.282[a] | 1 | 843.282 | 4.314 | .040 | .041 | 4.314 | **.539** |
| Intercept | 1532028.051 | 1 | 1532028.051 | 7837.059 | .000 | .987 | 7837.059 | 1.000 |
| Group | 843.282 | 1 | 843.282 | 4.314 | .040 | .041 | 4.314 | **.539** |
| Error | 19939.477 | 102 | 195.485 | | | | | |
| Total | 1640537.000 | 104 | | | | | | |
| Corrected Total | 20782.760 | 103 | | | | | | |

a. R Squared = .041 (Adjusted R Squared = .031)

b. Computed using alpha = ,05

**Table 5.3.6.2**

*Observed Power of Age-Groups Effect on EI Scores*

**Tests of Between-Subjects Effects**

Dependent Variable: expressions,totalscore

| Source | Type III Sum of Squares | df | Mean Square | F | Sig. | Partial Eta Squared | Noncent. Parameter | Observed Power[b] |
|---|---|---|---|---|---|---|---|---|
| Corrected Model | 915.950[a] | 3 | 305.317 | 1.537 | .210 | .044 | 4.610 | .395 |
| Intercept | 1602505.070 | 1 | 1602505.070 | 8066.243 | .000 | .988 | 8066.243 | 1.000 |
| Age | 915.950 | 3 | 305.317 | 1.537 | .210 | .044 | 4.610 | .395 |
| Error | 19866.810 | 100 | 198.668 | | | | | |
| Total | 1640537.000 | 104 | | | | | | |
| Corrected Total | 20782.760 | 103 | | | | | | |

a. R Squared = .044 (Adjusted R Squared = .015)

b. Computed using alpha = ,05

**Table 5.3.6.3**

*Observed Power of Both the Age-Groups & Sample Group on EI Scores*

**Tests of Between-Subjects Effects**

Dependent Variable: expressions,totalscore

| Source | Type III Sum of Squares | df | Mean Square | F | Sig. | Partial Eta Squared | Noncent. Parameter | Observed Power[b] |
|---|---|---|---|---|---|---|---|---|
| Corrected Model | 2549.859[a] | 7 | 364.266 | 1.918 | .075 | .123 | 13.426 | **.731** |
| Intercept | 1012902.384 | 1 | 1012902.384 | 5333.141 | .000 | .982 | 5333.141 | 1.000 |
| Age | 515.906 | 3 | 171.969 | .905 | .442 | .028 | 2.716 | .242 |
| Group | 252.166 | 1 | 252.166 | 1.328 | .252 | .014 | 1.328 | .207 |
| Age * Group | 1117.999 | 3 | 372.666 | 1.962 | .125 | .058 | 5.886 | .492 |
| Error | 18232.901 | 96 | 189.926 | | | | | |
| Total | 1640537.000 | 104 | | | | | | |
| Corrected Total | 20782.760 | 103 | | | | | | |

a. R Squared = .123 (Adjusted R Squared = .059)

b. Computed using alpha = ,05

**Table 5.3.6.4**

*Observed Power of the 5 Significant SSEIT Items on Differentiating Between the two Sample Groups*

**Tests of Between-Subjects Effects**

Dependent Variable: Group

| Source | Type III Sum of Squares | df | Mean Square | F | Sig. | Partial Eta Squared | Noncent. Parameter | Observed Power[b] |
|---|---|---|---|---|---|---|---|---|
| Corrected Model | 20.470[a] | 73 | .280 | 1.926 | **.024** | .824 | 140.633 | **.977** |
| Intercept | 57.615 | 1 | 57.615 | 395.829 | .000 | .930 | 395.829 | 1.000 |
| q3 | .037 | 4 | .009 | .063 | .992 | .008 | .251 | .061 |
| q16 | .088 | 3 | .029 | .202 | .894 | .020 | .607 | .083 |
| q19 | 1.528 | 4 | .382 | 2.625 | .054 | .259 | 10.500 | **.663** |
| q23 | .720 | 3 | .240 | 1.649 | .199 | .142 | 4.948 | .388 |
| q28R | 1.416 | 4 | .354 | 2.432 | .069 | .245 | 9.729 | **.625** |
| q3 * q16 | .207 | 1 | .207 | 1.421 | .243 | .045 | 1.421 | .211 |
| q3 * q19 | .161 | 3 | .054 | .369 | .776 | .036 | 1.106 | .114 |
| q3 * q23 | .733 | 2 | .367 | 2.519 | .097 | .144 | 5.039 | .466 |
| q3 * q28R | .970 | 4 | .242 | 1.666 | .184 | .182 | 6.663 | .449 |
| q16 * q19 | .337 | 2 | .168 | 1.156 | .328 | .072 | 2.312 | .234 |
| q16 * q23 | .000 | 1 | .000 | .000 | 1.000 | .000 | .000 | .050 |
| q16 * q28R | .652 | 2 | .326 | 2.238 | .124 | .130 | 4.476 | .420 |
| q19 * q23 | .350 | 3 | .117 | .801 | .503 | .074 | 2.404 | .202 |
| q19 * q28R | 1.211 | 4 | .303 | 2.080 | .108 | .217 | 8.318 | .548 |
| q23 * q28R | .083 | 1 | .083 | .573 | .455 | .019 | .573 | .113 |
| q3 * q16 * q19 | .207 | 1 | .207 | 1.421 | .243 | .045 | 1.421 | .211 |
| q3 * q16 * q23 | .000 | 0 | . | . | . | .000 | .000 | . |
| q3 * q16 * q28R | .000 | 0 | . | . | . | .000 | .000 | . |
| q3 * q19 * q23 | .062 | 1 | .062 | .429 | .517 | .014 | .429 | .097 |
| q3 * q19 * q28R | .000 | 0 | . | . | . | .000 | .000 | . |
| q3 * q23 * q28R | .000 | 0 | . | . | . | .000 | .000 | . |
| q16 * q19 * q23 | .174 | 1 | .174 | 1.195 | .283 | .038 | 1.195 | .185 |
| q16 * q19 * q28R | .000 | 0 | . | . | . | .000 | .000 | . |
| q16 * q23 * q28R | .000 | 0 | . | . | . | .000 | .000 | . |
| q19 * q23 * q28R | .000 | 0 | . | . | . | .000 | .000 | . |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| q3 * q16 * q19 * q23 | .000 | 0 | . | . | . | .000 | .000 | . |
| q3 * q16 * q19 * q28R | .000 | 0 | . | . | . | .000 | .000 | . |
| q3 * q16 * q23 * q28R | .000 | 0 | . | . | . | .000 | .000 | . |
| q3 * q19 * q23 * q28R | .000 | 0 | . | . | . | .000 | .000 | . |
| q16 * q19 * q23 * q28R | .000 | 0 | . | . | . | .000 | .000 | . |
| q3 * q16 * q19 * q23 * q28R | .000 | 0 | . | . | . | .000 | .000 | . |
| Error | 4.367 | 30 | .146 | | | | | |
| Total | 293.000 | 104 | | | | | | |
| Corrected Total | 24.837 | 103 | | | | | | |

a. R Squared = .824 (Adjusted R Squared = .396)

b. Computed using alpha = ,05