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UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG
SCHOOL OF HUMAN AND COMMUNITY DEVELOPMENT
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Research Report

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The role of executive function and socioeconomic status on risk-taking behaviours in the low-to-middle income context of South Africa.

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Master's by Coursework and Research Report – Research Report Declaration

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Title: **The role of executive function and socioeconomic status on risk-taking behaviours in the low-to-middle income context of South Africa.**

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Abbreviations List

AUDIT- Alcohol Use Disorders Identification Test

BART- Balloon Analogue Risk Task

BIS-Barratt Impulsiveness Scale

C- Colour Score

CW- Colour-Word Score

DSB- Digit Span Backwards

DSF- Digit Span Forwards

DSS- Digit Span Sequencing

EF- Executive Function

IGT- Iowa Gambling Task

LDSD- Longest Digit Span Backwards

LDSF- Longest Digit Span Forwards

LDSS- Longest Digit Span Sequencing

LEAP-Q-SV- Language Experience and Proficiency Questionnaire, Shorten Version

LSM- Living Standards Measure

LTC- Long-Term Consequences

PFC- Prefrontal Cortex

SA- South Africa

SAARF- South African Advertising Research Foundation

SES- Socioeconomic Status

SMH- Somatic Marker Hypothesis

W- Word Score

WEIRD- Western, Educated, Industrialised, Rich, and Developed

WM- Working Memory

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Abstract

Risk taking is a multifaceted construct that can shape our daily decision-making processes. Higher order cognitive processes, specifically executive functioning, underscore risk-taking behaviours, while wider socio-demographic factors, such as socio-economic status, can be related to both executive function and risk-taking. However, the relationship and interplay between these factors is unclear. Accordingly, the primary aim of the study was to investigate how socio-economic status (SES) is associated with executive function (EF), specifically inhibitory control and working memory (WM), and how this association may influence risk-taking behaviour. A non-experimental and cross-sectional study was conducted using a sample of 96 participants, recruited from Johannesburg, Limpopo, and KwaZulu Natal provinces in South Africa. A comprehensive measure of SES was used, drawing on both objective and subjective ratings. Working memory was assessed by the Wechsler Digit Span test and inhibitory control using the Stroop Colour and Word Test. Lastly, a digital task - the Iowa Gambling Task (IGT) - was used to assess risk-taking behaviours. Overall, participants presented with good WM abilities but low inhibition. The IGT showed that participants were more inclined to risk-taking behaviours, however they showed a positive shift in decision making throughout the task, with no association found between EF and risk-taking behaviours. Furthermore, SES was not a predictor of EF abilities or risk-taking behaviours within the current sample. Furthermore, EF did not predict risk-taking behaviours. The results of this study are multifaceted and suggest that these constructs are multidimensional in nature and measuring them are associated with methodological challenges. Nevertheless, there is some preliminary evidence to suggest that these constructs play an interrelated role.

Keywords: Executive Functions; Inhibition; Iowa Gambling Task; Risk-taking behaviours; Socio-Economic Status; Working Memory.

Chapter 1: Introduction

1.1 Background

The majority of activities that people engage in daily and throughout their lives are driven by their decision-making behaviours. Decision-making, as a complex behavioural process, involves a degree of risk-taking and executive function (EF) cognitive capabilities (Ouerchefani et al., 2019). Risk-taking can also be conceptualised as a type of decision making. Both risk-taking and decision-making require balancing out the consequences of a situation and selecting the appropriate option almost anatomically (Balogh et al., 2013). Both processes further rely on similar brain networks (Balogh et al., 2013; Dohmen et al., 2018), such as the frontal pole of the prefrontal lobe, orbitofrontal cortex, visual cortex, and the cerebellar posterior lobe (Guo et al., 2013). Balogh et al. (2013), further argues that risk-taking behaviour is decision-making made under conditions of uncertainty and can lead to negative consequences when the appropriate decision-making processes are not employed. The collective construct encompassing those processes behind decision-making that may affect risk-taking behaviour is EF. EF is largely responsible for regulating behaviour and thoughts (Doebel, 2020). Its' processes provide individuals with the ability to make decisions while assessing risks and planning for the future (Monteiro, 2022). The Somatic Marker Hypothesis (SMH) guides decision-making in which EF, such as working memory and inhibition, play a vital role. This highlights the shared association between decision-making, risk-taking behaviour, and EF.

Furthermore, human development is influenced by human diversity, which comprises of factors such as ethnicity, social class, religion, caste, sexual orientation, regional diversity (e.g., urban or rural origins), cultural traits and digital access (Sakshi, 2021). This emphasises the multifaceted nature of human development, resulting in cognitive processes not occurring in isolation. To illustrate, the interplay between sociodemographic risks and parenting styles, can influence EF (Holochwost et al., 2016). Sociodemographic risk is a composite measure of SES and demographic risks, such as single parenting, low maternal education, poverty, high number of children in the home, and teenage pregnancy/motherhood to name a few and parenting styles are categorised into sensitivity, negativity, and intrusiveness. Particularly, Holochwost and colleagues' study, looked at the relationship between sociodemographic risk, parenting styles, and EF on children during infancy and toddlerhood. Their results showed that as socio-demographic risks increased, parenting styles decreased in quality, resulting in

lower performance on EF tasks among children. This is seen mainly during the infancy period of the child and less during the toddlerhood phase. Furthermore, their study results varied among ethnicity, such that increased parenting style of sensitivity was associated with improved EF performance among European American children, however, the increased parenting style of negative and intrusiveness, was associated with a decline in EF performance among African American participants.

Therefore, higher-order cognitive processes such as risk-taking behaviours and EF can arguably be influenced by wider and complex socio-demographic and cultural factors. The influence of socioeconomic backgrounds on EF has recently gained increased interest in the literature. The main pattern is the presence of a positive association between socioeconomic status (SES) and EF, such that high socioeconomic backgrounds are associated with higher EF performances (Mousavi et al., 2022). However, as Mousavi further argues, the conceptualisation and operationalisation of socioeconomic backgrounds impact this association and there are emerging studies which yield contrasting results. In light of the above, the current study focused on the influence of SES on EF, specifically inhibitory control and working memory, and on risk-taking behaviour.

1.2 Rationale

The main rationale for the study stems from the complex interplay between SES, EF, and its potential influence on risk-taking behaviour. The association between SES and EF is of great interest with an extensive number of studies exploring this association. Although the majority of the studies support the understanding that SES predicts EF, the results are inconsistent with recent studies disputing the association. For instance, the overall results from John et al. (2019) and Lawson et al. (2018), highlighted the SES-EF discrepancy, whereby lower SES was linked to lower EF abilities. However, contradicting results were obtained from studies by Howard et al. (2020) and Freitas et al. (2022).

Similarly, studies exploring risk-taking behaviour lack a definitive conclusion regarding its association with SES and EF. Studies have shown that individuals from a high SES are more likely to be less risk aversive (Weissberger et al., 2022). In reference to low SES, some studies show that these individuals are risk-aversive whereas some argue that they are risk-takers due to a lack of stability in relation to their financial situations and futures (Sheehy-Skeffington, 2020). Furthermore, studies have attempted to show the presence of hot and cold

EFs in the decision-making process, however, the way in which EF together with its hot and cold counterparts influences decision-making lacks consensus (Colautti et al., 2022).

In addition to the inconsistency among findings, the majority of the studies, particularly those focusing on EF, are mainly conducted on children and within high-income counties (Obradović et al., 2019). It is commonly understood that EF is largely shaped and developed in response to early life experiences, making the early infancy and childhood periods predictive of EF development. Hence, most research focuses on young children. However, EF and risk-taking behaviours can continue to develop until early adulthood and beyond (Ogilvie et al., 2020). Additionally, as discussed by Sakshi (2021), development does not occur in isolation and is therefore a dynamic process. Thus, this research sample focused on an adult population, within a low-to-middle income country.

Overall, the majority of studies were conducted in Western, Educated, Industrialised, Rich, and Developed (WEIRD) countries, neglecting the low-to-middle income countries. Such results cannot be generalised to non-WEIRD countries due to various biases and differences. However, it is argued that studies conducted in low-to-middle-income countries produce results that are analogous to studies conducted in high-income countries (Orbradović & Willoughby, 2019), which can be seen in studies conducted in low-to-middle income countries like South Africa (SA). Specifically, Cockcroft (2022) tested if working memory (WM) models, developed in WEIRD countries, are applicable to non-WEIRD countries. In this study, a comprehensive battery of WM tasks was administered on a sample of Black African young adults in SA. After conducting a confirmatory factor analysis using five models of WM, the results suggest that a four-factor model of WM was the best influence on the structure fit, but that sociocultural and economic contexts can influence the structure and development of WM.

Taken together, the overall aim of the current study was to bridge the gap through exploring the association of SES on EF and risk-taking behaviour within a low-to-middle income context, like SA. The study was targeted on an older sample size, as most EF research is conducted on children. Additionally, it aims to unpack the methodological aspects of studies which may be a contributing factor to the lack of consensus among the constructs under study.

Chapter 2: Literature Review

2.1 Risk-Taking Behaviour

Decision making is a daily cognitive process, with personal and social implications. The capacity to make decisions is largely a result of cognitive functioning and processes. These include understanding, appreciation, reasoning, values, and communication (Peterson, 2019). Moreover, individuals with normal cognitive aging are shown to have a slower processing speed and thus require more time to make a decision (Tannou et al., 2020). Additionally, it involves balancing out the consequences and rewards of a particular situation (Balogh et al., 2013). Hence, good decision making is based on choosing the appropriate strategies, which involves the prefrontal cortical region, particularly the ventromedial portion which is important for decision making and reasoning (Wiesiolek et al., 2014).

Impaired decision-making capacity is found in patients with traumatic brain injury, frontotemporal dementia, Parkinson's disease, substance dependent patients, and patients with frontal lobe and cerebellar damage caused by cerebrovascular accidents (Broche-Pérez et al., 2016), to name a few. As such, these individuals are prone to making decisions which yield negative consequences. However, on the contrary, neurologically healthy individuals further engage in decision making which yields undesirable outcomes to themselves or others. Thus, individuals, irrespective of their neurological status, can engage in decision-making with adverse effects. An underlying factor for this is the need for immediate gains without accounting for future consequences that could be negative in nature. This according to Balogh et al. (2013), results from poor decision making. Within their manuscript of reviewing the literature concerning risk-taking and decision-making in adolescents and the relationships that these constructs have on addictions, Balogh discusses that poor social decision-making is largely a result of damage to the ventromedial area of the prefrontal cortex (PFC). However, poor decision making can further be seen in healthy individuals, whereby emotional states may override rational reasoning in favour of immediate rewards. This results in the exhibition of poor decisions. Additionally, when decisions are driven by emotion, they may be observed in risk-taking behaviours such as self-harm behaviours, consumption of drugs and alcohol, and consequently addictions. This highlights that risk-taking behaviours are prevalent when decisions are made for immediate outcomes.

Risk-taking behaviour is decision making whereby an individual is highly inclined to decide on an option or action that results in personal or social harm (de Jager & Naudé, 2018). As

such, the effect of risk-taking behaviour is shown to influence the risk taker and individuals surrounding them, making it, to a certain extent, a social phenomenon. Furthermore, risk-taking behaviour is directly linked to either a reward or loss, whereby a risk-taking individual is focused on immediate gain or gratification as opposed to the long-term benefits or consequences (Reynolds et al., 2019). Additionally, both lack effective planning and consideration of the resulting consequences, which are then likely to yield negative consequences in comparison to the positive (Balogh et al., 2013). This is supported by the types of risk-taking behaviour. As claimed by Fryt and colleagues (2022), it comprises of negative behaviours such as engaging in criminal activities, gambling, addiction, binge drinking, and risky driving. Furthermore, risk-taking behaviour is argued to occur in all domains of life, such as financial assets, consumer buying and within the health aspect (Dohmen et al., 2018). This highlights that risk-taking behaviour is present in all aspects of daily life and that extreme cases may lead to ongoing negative behaviour, such as criminal activity and addiction.

From a neurological perspective, risk-taking behaviour is largely a result of brain areas and functions, particularly the dopamine neurons, striatum, orbitofrontal cortex, medial PFC, posterior cingulate and the parietal cortex (Dohmen et al., 2018). To investigate the relationship between specific brain areas and varying decision-making tasks, Guo and colleagues (2013), conducted an fMRI study on individuals with normal cognitive function. The results indicated a large network of neural correlates for decision-making processes. Specifically, when participants engaged in risky decision making, significant activation was found in the prefrontal (dorsolateral and prefrontal lobe, frontal pole of prefrontal lobe, orbitofrontal cortex) and frontal cortex (i.e. precentral gyrus) as well as in the inferior parietal lobe, middle temporal gyrus, temporal pole, and extending to the visual cortex. There was further a relationship found between the mid-brain structures when engaged in risky decision-making (Guo et al., 2013). Furthermore, when engaged in ambiguous decision-making, the sample presented with activation in the prefrontal, temporal (inferior temporal gyrus), and occipital lobe, as well as in the visual cortex.

The above is further supported by Broche-Pérez et al. (2016) who reviewed the anatomical structures underlying the process of decision-making. The review highlights the importance of the PFC involved in decision-making, particularly the orbitofrontal cortex, the anterior cingulate cortex, and the dorsolateral PFC. Each region assists decision making according to their function, such that the orbitofrontal cortex is associated with rewards and punishments as well as emotional processing, whereas the anterior cingulate cortex and the dorsolateral PFC

is largely associated with monitoring WM and regulating the retrieval of information, respectively. This highlights a large network of brain structures correlated with decision making, be it risky or ambiguous, further emphasising the multifaceted processes and the range of cognitive functions.

According to Balogh et al. (2013), alterations within the biological system can influence risk taking. This is in light of the fact that the PFC, processing through interactions with the parietal area together with other brain structures, plays a role in controlling behaviour, attention, decision making as well as emotional regulation. This is further seen in the changes in the type of risk-taking behaviours that individuals engage in based on their age and developmental period (Wang et al., 2024). As further discussed by Wang and colleagues, adolescents experience an imbalance between cognitive control and reward-systems, resulting in the adoption of decisions that yield immediate gratification. However, as individuals develop into adults, risk-taking behaviours are known to decrease, emphasising an inverse-U pattern of the presence of risk-taking behaviours across development. This is supported by a study conducted by Sandor and Gürvit (2019), who examined the changes in decision making from adolescents to young adulthood. After dividing the sample into three groups based on age, young group (age 12-14 years), intermediate group (age 15-17 years), and an older group (18-20 years), their results indicated that the older group made significantly more positive choices on the risk-taking task in comparison to the former two groups.

In assessing the link between cognitive ability and risk-taking, Dohmen et al. (2018) found that individuals with low cognitive abilities self-report that they will be less likely to engage in risk-taking behaviours. This is based on a country level analysis, using the OECD Programme for the International Assessment of Adult Competencies as a measure. As agreed above, as cognitive functions and the paired neural correlates appear to underlie risk-taking behaviour, what follows is that all individuals possess the capacity of engaging in risky behaviour. This is supported by Dohmen and colleagues (2018), who, based on a review study, further argue that risk-taking is a dormant state present within all individuals, however acting on these risk-taking tendencies varies among individuals. This dormant state of risk-taking behaviours is further seen in what is referred to as positive risks which is understood as risks that are beneficial on both an individual and social level (Fryt et al., 2022). These risks include, but are not limited to, learning new skills, standing up for one's beliefs, as well as engaging in new and challenging activities. Thus, on an individual level it promotes growth, and, on the latter, it is socially acceptable. Therefore, individuals are prone to risky behaviour which are either positive or

negative, however the tendency to engage in them is not overtly observable; however, it can be assessed through evaluating how individuals make decisions.

Although there is no universal way of measuring risk-taking (Lejuez et al., 2002), there are two categories that can be used to measure risk-taking behaviour, namely, self-reported measures and behavioural tasks (Balogh et al., 2013). Self-reported measures are administered in correlation to the specific risk behaviour that is under assessment, whereby individuals are asked to rate their level of risk-taking behaviour in general or in relation to a specific behaviour (Mamerow et al., 2016). Lejuez and colleagues (2002), provide examples of such self-report measures in their study which examined a behavioural measure of risk-taking, the Balloon Analogue Risk Task (BART) to self-report measures. The Sensation Seeking Scale was used to measure sensation and impulsivity by asking participants to answer questions around thrill, adventure seeking, experience seeking, disinhibition, and boredom susceptibility. They also drew on the Barratt Impulsiveness Scale that asked participants questions regarding their motor (actions lacking thought), cognitive (rapid cognitive decisions), and future planning impulsivity (disregard for the future). Drinking usage was measured using the Alcohol Use Disorders Identification Test (AUDIT), which is a 10-item self-report measure where participants report their quantity and frequency of drinking, their intensity, as well as their dependence and tolerance associated with alcohol. Gambling addiction was measured by the Oaks Gambling Screen (OGS) whereby participants are to report on their gambling behaviours. Both the AUDIT and OGS assess behaviour over the past 12 months.

The shorter version of the Barratt Impulsiveness Scale, BIS-15, measures three forms of impulsivity, namely: (1) non-planning impulsivity, such as lack of future orientation; (2) motor impulsivity whereby actions are carried out without thoughts; and (3) attentional impulsivity which lacks the ability to focus or concentrate (Meule et al., 2020). The traits such as lack of planning, which is measured by the BIS- 15, are, as discussed above, part of risk-taking behaviour. Hence, this self-report measure assumes that impulsivity (that falls under EF) and risk-taking are associated, such that they share common traits. The BIS-15 has been used in both psychiatric, such as individuals with mental health disorders, and non-clinical samples, such as healthy individuals. According to a confirmatory factor analysis conducted by Meule and colleagues (2020), the BIS-15 provides a viable alternative for the original BIS form, making it a valid measure of impulsivity that is used in various studies as a measure of risk-taking. Sensation seeking is associated with traits that inclines individuals to pursue social and physical risks to experience novel and complex sensations and experiences; thereby making it

associated with risk-taking (Manna et al., 2013). Form V of the Sensation Seeking Scale (SSS-V) is argued to be a standard and frequent measure to assess sensation seeking and can be translated in several languages. Based on a factor analysis conducted by Manna et al. (2013), the SSS-V may comprise of cultural and generational bias, however this was found in an Italian sample investigating country specific cultural factors and may not be extended to other cultures. Nevertheless, the overall conclusion of the analysis revealed that the SSS-V is viable for measuring sensation seeking.

The above are self-reported measures whereby individuals are required to rate their likelihood of engaging in the given activities. However, as Lejeuz et al. (2002) argue, the test scores from self-reported measures are not always accurate. This is since individuals are likely to provide false answers and the measure itself may not accurately gather the negative consequences of risk-taking behaviours. Nevertheless, in light of these shortcomings with regards to self-report measures, behavioural assessments are considered.

A common behavioural assessment used in studies is the BART. The BART was designed by Lejuez and colleagues (2002) and is essentially a computer-based assessment which comprises of risky behaviour that closely resembles real-world scenarios (Lejuez et al., 2002). For this assessment, participants are provided a digital device, whereby a balloon, a pump and a reset button are available. Participants are required to pump the balloon, whereby each pump results in gaining money, and the amount of money collected is displayed on screen. However, once the balloon reaches a certain point, it pops and the participant loses all the money that was collected, however, participants are allowed to stop pumping and collect their money prior to reaching the balloon's full capacity. This assessment therefore shows how far people are willing to go or the number of risks they are willing to take to increase their monetary gains. Based on their study, Lejuez and colleagues (2002) concluded that the BART together with self-reported measures of risk-taking could be used simultaneously to yield a more accurate way of assessing risk-taking behaviours among individuals as opposed to solely using either a self-report or behavioural measure.

Another common behavioural measure of risk-taking behaviours is the Iowa Gambling Task (IGT). The IGT was originally developed by Bechara et al. (1994) to measure decision making in patients with impairments in the ventromedial region of the prefrontal cortices. These patients were observed as consistently making decisions which yielded negative outcomes. However, as further argued by Bechara and colleagues as well as supported by Damasio et al.

(1996), these patients were observed to be intellectually healthy with the presence of unimpaired cognitive abilities. Hence, the IGT was developed to assess these decision-making impairments among these individuals. (For a full description of the IGT, see below).

Moreover, more recently, the IGT has been used as a measure of risk-taking behaviours as it can measure decision making under two conditions, namely under ambiguity and under risk. In the former case, there is uncertainty in relation to the positive or negative outcome of a choice, whereby at least one possible outcome is unknown. On the other hand, decision making under risk occurs when the possible outcomes are known and additional information can be obtained to make an informed decision (Colautti et al., 2022; Ouerchefani et al., 2019). Within the IGT, initially participants are unaware of the outcome options, and are thus potentially deciding under conditions of ambiguity. However, as they become familiar with the outcome options, they gradually begin to shift towards decision making under risk. This highlights the risk-taking aspect of the IGT as individuals are aware of the outcomes and are required to make a decision by evaluating the immediate gains and future consequences. Based on this performance, their risk-taking tendencies are assessed. As such, the IGT is validated for both healthy and neurologically impaired individuals.

Furthermore, in support of the claim above regarding cognitive ability and risk-taking, Dohmen et al. (2018), argue that cognitive ability can be measured using risk-taking in three different ways, namely through, observing risk-taking in everyday life; observing risk-taking in standard settings and measuring self-reported claims about risk-taking. This highlights the interconnectedness between risk-taking behaviour and cognitive ability, such that both factors are constantly influencing each other.

2.2 Executive Function

A construct linked to risk-taking is EF. EF can be understood as an umbrella term for the connected yet distinct cognitive abilities that are facilitated by the PFC (Nyongesa et al., 2019). Hence, risk-taking and EF are associated through a shared brain region, the PFC. EF is responsible for providing individuals with the ability to control their emotions and socially interact (Nyongesa et al., 2019) as well as to regulate and engage in independent, purposeful and goal directed behaviour (Doebel, 2020; Nyongesa et al., 2019).

Much like decision making and risk-taking, EF is required daily, as through its regulation function, it provides individuals with the ability to disengage from habits, make decisions while assessing risks, plan for the future, arrange and plan actions as well as handle situations that

we may encounter on a daily basis (Monteiro, 2022). This highlights the shared relationship between making decisions, taking risks and EF, such that EF is required and involved in the former two. This is supported by Peterson (2019) who claims that with reference to behavioural data, EF is strongly associated with one's capacity of decision making as EF involves the ability to concentrate on a stimulus and manipulate information for problem solving. Moreover, based on a previous systematic review, he concluded that EF measures are more commonly associated with understanding, appreciation, and reasoning, which are factors of decision making. Furthermore, the broad consensus regarding EF is that it is multidimensional in nature and may be understood as maintaining three broad functions, specifically, working memory (WM), inhibitory control, and cognitive flexibility (Diamond, 2013; Doebel, 2020; Monteiro, 2022). For the purpose of the current research, only inhibitory control and WM was explored.

Inhibitory control involves the ability to regulate and take charge of one's attention, behaviour, thoughts, and emotions. This control prevents individuals from acting according to one's temptations and impulsiveness (Diamond, 2013), allowing individuals to act rationally in respect to a particular situation. This further implies that inhibitory control is essential for what is referred to as goal-directed behaviour (St John et al., 2019). This is a result of the inhibitory control system inhibiting impulses, allowing one to exhibit a rational behavioural response towards achieving an action or goal as opposed to acting out of impulsivity. An additional factor under inhibitory control is self-control. As Diamond (2013) explains, self-control is about taking charge of one's behaviour, preventing us from acting out of temptations. Lastly, Diamond (2013) mentions another aspect of inhibitory control, namely that of attention. Inhibitory control involves attention as being able to complete a goal directed behaviour requires a large amount of focus and concentration so as to not allow for distractions that could act as a barrier to completing the goal at hand. From this, it can be argued that EF, particularly inhibitory control, is closely associated with risk-taking, such that many of the functions of the inhibitory control system are used to prevent risk-taking behaviours.

Similarly to risk taking, the functioning of inhibitory control processes can be measured using different neuropsychological assessments, depending on the specific process under investigation (Diamond, 2013). Performance-based measures of EF include tasks such as the Wisconsin Card Sorting Test, the Trail Making Test (Nyongesa et al., 2019), and the Stroop Colour-Word Test (Jensen, 1965). To obtain a more comprehensive assessment of EF, measures can be assessed in a set of neuropsychological measures such as the Delis-Kaplan Executive Function System (Homack et al., 2005), Cambridge Neuropsychological Test Automated

Battery and a developmental Neuropsychological assessment battery (Nyongesa et al., 2019). It is important to note that currently there is a debate in the field as to whether the tests accurately measure inhibitory control (Diamond, 2013).

WM may be understood as the process of obtaining information, consciously retaining it in the mind and simultaneously working with it in our mind (Diamond, 2013; St John et al., 2019). As further explained by Owen et al. (2005), the general characteristics of WM are that it is a cognitive system which temporarily stores and manipulates information. This type of memory is further active for a brief period as it functions to hold information with the aim of guiding behaviour when external cues are unavailable. Moreover, as explained by Cockcroft (2022), WM mainly comprises of visuospatial and verbal information whereby it then gets processed into long term memory. Cockcroft further explains that the WM system is essential for cognitive functions such as learning, decision making, problem solving, interpersonal skills, self-regulation, and resilience. It is further essential for cognitive tasks which require information to be held and manipulated for a brief period (Barak & Tsodyks, 2014). Additionally, WM allows us to utilise our knowledge into our decision making, as well as consider our past and future when we engage in formulating plans and decisions (Diamond, 2013). As such, through WM, we are able to learn to distinguish which actions are prone to risk-taking behaviour. It further allows us with problem solving abilities to work our way out of risky situations. This illustrates that WM is closely associated with the risk-taking aspect of decision making.

Deficits in WM is seen in individuals with autism (Monterio, 2022) and Attention-Deficit/Hyperactivity Disorder (Alloway & Cockcroft, 2014), language impairment (Montgomery & Evans, 2009) as well as Fetal Alcohol Syndrome (Paolozza et al., 2014). Like inhibitory control, WM can be measured using a number of varying assessments. As argued by Diamond (2013), these include but may not be limited to, Forward and Backward Digit Span Task (Groth-Marnat & Baker, 2003), Corsi Block Test (Siddi et al., 2020), and the n-Back (Owen et al., 2005).

Furthermore, the shared association between decision-making and EF are supported by the Somatic Marker Hypothesis (SMH). The SMH postulates that in uncertain situations, second-level processing of the emotion system supports the process of rational decision-making (Chiu et al., 2018). It was originally developed by Damasio et al. (1996) in response to patients with impairments in the ventromedial PFC, who presented with intact language abilities, attention,

memory, and pertinent knowledge. Despite their healthy cognitive abilities, these patients were inclined to making negative decisions across various domains such as types of friends, planning, organisation, finances, health, and social interactions. It was noticed that these patients had difficulty with emotions and feelings. Taking this into account Damasio and colleagues developed the SHM as a larger theoretical framework, such that when an individual is presented with a situation, factual knowledge such as actions and potential short and long-term outcomes are evoked through sensory images. Thereafter, signals related to these images are acted upon by the ventromedial PFC which allows for the reactivation trigger of somatosensory patterns which describe an appropriate emotion. Hence, when engaged in decision-making, the frontal area of the brain allows the individual to recall past information and corresponding emotions to make logic-based and cost-benefit analyses of the available options, allowing for effective decision-making in a short period of time. On the contrary, impairments with recollection of either past information or emotions results in negative decision-making. Thus, the presence of the WM and emotional systems cooperate for effective decision-making.

To test the SHM, the IGT (as mentioned above and fully described below) was administered on patients with impairments on the ventromedial region of the PFC as well as on healthy controls. The controls performed well whereas the patients consistently made choices that yielded negative outcomes (Damasio et al., 1996). Based on the results, Damasio and colleagues argue that during one's engagement with the IGT, participants are to rely on their 'sense/gut feeling' to determine the risky outcomes from the non-risky outcomes. As mentioned above, the IGT measures decision-making under ambiguity and risk (Colautti et al., 2022; Ouerchefani et al., 2019). It is argued that decisions made under ambiguity and under risk are a result of the involvement of EF processes, particularly the affective - 'hot'- and cognitive - 'cold'- factors of EF. Cold EF are functions which are guided purely by cognition and processes such as planning, set-shifting, WM, and inhibition. On the other hand, hot EFs are guided by emotions and motivation (Colautti et al., 2022; Demaree et al., 2010). These hot and cold functions are essential aspects of the SHM and can further be measured by the IGT. This highlights the SMH, as memory and emotional systems are necessary in making healthy decisions (Damasio et al.,1996).

In light of the above discussion, it can be deduced that risk-taking behaviour as well as the inhibitory control and WM aspect of EF are interlinked processes. The consensus is that risk-taking behaviour is more common among adolescents, as a result of immature EF systems.

However, the literature to support this is lacking (Ogilvie et al., 2020). Hence, Ogilvie and colleagues (2020) conducted a study to investigate the neuropsychological aspects of EF among adolescents transitioning into early adulthood, focusing on the ages 17 to 22. They examined the relationship between EF and risk-taking behaviours within this age group. The study found that EF development was largely complete by this stage of life. Additionally, their findings indicated that individuals at the peak of early adulthood were more likely to engage in risk-taking behaviours compared to adolescents. However, the risk-taking behaviours observed were more likely to result in positive outcomes rather than negative ones. The authors also noted that weak EF did not correlate with higher risk-taking behaviours in their sample, suggesting that the participants' generally well-developed EF could explain this lack of association

On the other hand, other studies have found conflicting evidence suggesting that EF and associated brain areas in the PFC continue to undergo rapid change and development during the adolescence period (Blakemore, 2018). Sarah-Jane Blakemore, as one of the pioneers in the field of adolescent brain development, has conducted a host of studies with collaborators to argue that adolescence is a sensitive period in brain development (Blakemore, 2012; Foulkes & Blakemore, 2018), for EF (S. Blakemore & Choudhury, 2006), decision making (S. Blakemore & Robbins, 2012), and risk-taking behaviours (Blakemore, 2018 ; Tomova et al., 2021) more specifically.

Nevertheless, these results highlight the phenomenon that individuals with well- developed EF are more likely to engage in risk-taking behaviours that result in positive consequences. This further makes salient the idea that the developmental status (well developed or immature) of our EF may be linked to the nature of risky behaviour that one engages in; such that well developed EF will be linked to positive risky behaviours.

2.3 Socioeconomic Status

On the interconnectedness between risk-taking and EF, what is less clear in the literature is the relationship between these neurocognitive factors and the wider social context, including key variables like SES. SES is understood in relation to a family's access or possession of economic and social resources. More specifically, it encompasses access to economic resources, social resources such as education, family characteristics such as parenting styles and involvements as well as stresses in life (Lawson et al., 2018). Additionally, SES can be attained on a neighbourhood level which are environmental factors, such as employment opportunities,

access to healthcare facilities, under-resourced schools, exposure to environmental toxins, and violence or abuse (Noble & Giebler, 2020). SES may further include social positioning and prestige that result from one's economic and social resources (Duncan & Magnuson, 2012). As such, this multifaceted nature of SES makes the conceptualisation, and consequently the operationalisation, of SES relatively complex.

Measuring SES involves various methods, each offering unique insights into economic and social conditions. Howe et al. (2012) outline several SES measures relevant for epidemiological studies in low- and middle-income countries. These include the wealth index, education, occupation, income and expenditure, the living standards measurement, and community-level measures. Based on a scoping review, these measures were found to be the commonly used SES measures in South Asian urban health studies (Saif-Ur-Rahman et al., 2018). Howe and colleagues explain each measure in greater detail. The wealth index aggregates data on asset ownership and household characteristics to provide a composite measure of economic well-being, and education reflects the level of formal education attained and serves as a representation for socioeconomic position. Occupation measures the type and status of employment, indicating economic stability and social standing. Income and expenditure are direct measures of financial resources, whereas the living standards measurement assesses housing quality, access to utilities, and possession of durable goods, offering a broader picture of economic conditions. Lastly, community-level measures aggregate socio-economic conditions at the neighbourhood level, capturing contextual influences. These diverse methods ensure a comprehensive assessment of SES across various contexts.

Therefore, it can be argued that SES cannot be measured from a single dimension as this prevents the obtainment of a comprehensive SES of an individual. However, when including several dimensions in the measurements of SES, obtaining an accurate representation of one's SES remains a challenge (Farah, 2017). As elaborated by Farah, when research participants are presented with questions concerning their SES, they have difficulty recalling their family's income or educational attainment and the SES situation of their neighbourhood can only be accurately captured through government databases. Additionally, the concept of household income is understood as the combined income of all members in the household (Duncan & Magnuson, 2012). As such, participants may not be aware of this information providing an estimation as opposed to an accurate response. Moreover, the number of employed and unemployed members in the house can further influence SES responses and this information is

often not obtained by researchers. For example, two participants may have similar household incomes, but one may classify themselves in a high social class and the other in a low, mainly due to the number of members in the household. Hence, capturing an accurate account of one's SES is a challenge.

SES factors are said to have a significant impact on one's cognition and behaviour, as well as social, emotional, and health outcomes, with the majority of the literature supporting an inverse association between SES and cognition (Fendinger et al., 2023). As discussed by Fendinger and colleagues, individuals with lower SES tend to underperform on cognitive tasks of language, attention, WM, and EF. In reviewing the data that explored SES and brain structure, Noble & Giebler (2020) found that SES is highly correlated with cortical and subcortical gray matter as well as white matter. Increased cortical surface area and thickness as well as gray matter volume support the development of language, attention, EF, emotion regulation, and memory. On the contrary, Fendinger and colleagues argue that individuals of a lower social class are interdependent, reliant on others, whereas individuals of a higher social class are independent. As such, individuals of a lower social class outperform those from a higher social class on social-cognitive tasks which are focused on showing understanding and empathy towards others. However, higher social class individuals perform better on non-social cognitive tasks which are cognitively intensive. As such, SES can play an influential role on one's educational achievements, social engagement, as well as mental and physical health (Howard et al., 2020).

It is important to note that literature concerning SES and cognition are normally conducted on children. As seen above, SES is correlated with cortical and subcortical gray matter as well as white matter. Since infancy is a sensitive period for brain development, environmental factors, such as SES, can contribute to the development of these neural networks (Farah, 2017). As such, it is argued that SES can affect infant brain development from as early as the first year of life (Noble & Giebler, 2020). This further indicates that children who are exposed to low SES from an early age tend to have less cortical thickness and surface areas, hindering their performances in cognitive tasks and slowing their school readiness.

It is further argued that parental education is correlated with children's cognition. Specifically, parents with higher education spend relatively more time with their children and stimulate their cognitive development through having high expectations of their children, exposing their children to material and activities that are educational and stimulating towards their learning,

as well as through conversing with complex language and speech patterns (Duncan & Magnuson, 2012). This is further elaborated by Obradović & Willoughby (2019), who argue that SES attainment determines the type of toys, books, outings, and activities that children are exposed to, and this can influence the development of cognitive abilities. Furthermore, as explained by Duncan and Magnuson, some jobs, irrespective of it being dependent on educational attainment, are more cognitively demanding than others. Hence, parents in highly cognitive work environments tend to develop enhanced cognitive abilities, which they can impart onto their children. However, SES is not static and can rapidly change throughout a child's schooling year. This change, as mentioned by Duncan and Magnuson, can occur from changes in parental educational levels, job placements, as well as family structure. As such, the association between SES and cognition, particularly among children, is dynamic and influential on several factors. This emphasises the challenges of measuring both SES and cognition in children, which can be expanded to a broader population.

The association between SES, risk-taking behaviour, inhibitory control, and WM has been of growing interest in the literature within the field of psychology, neuropsychology, and economics. Moreover, Lawson and colleagues (2018) provides three vital reasons behind understanding the relationship between EF and SES. Firstly, this relationship provides insights to understanding human development and accounting for individual differences, such as SES. EF is indicative of life achievements, namely academic performance, health behaviours and mental well-being. Lastly, SES plays a role in research, such that these factors can influence performance of assessments. Thus, SES plays a big role in daily life and human development.

The process of the development of EF is part of human development. As such it is understood that EF begins to develop between the ages of 3 and 6 (St John et al., 2019). Hence, assessments can be used to measure school readiness for children, since EF is linked to academic performance. Moreover, measuring EF in relation to SES can provide insights as to how SES affects the development of EF. As such, St John and colleagues (2019) conducted a study to examine how SES is related to EF processing among children between the ages of 4.5 and 5.5. In particular, they examined accuracy and reaction time, cognitive load and WM. Based on their results, they discovered that children with lower SES presented with a low accuracy in the Go/No Go task, indicating poor inhibitory control and vigilance. Overall, they concluded that low SES is related to poorer EF performance for the given sample group. However, for certain aspects of EF that were still developing for this age group, SES did not have any

influence. Therefore, this study reveals that low SES results in lower EF functioning among children.

To explore the association between SES and EF, Howard et al. (2020), conducted a study using data from low-middle income countries, particularly, SA and high-income countries, namely Australia. They measured EF among preschool children, making the sample age range between 3-5. Specifically, they used the Mr Ant measure for WM, Go/No Go for inhibition and Card Sort for cognitive flexibility. Their results indicated that the South African children had a higher performance on two out of the three EF tasks, in comparison to the Australian children. That is, despite the SES differences at a country level, EF was not compromised as expected. As explained by the authors, a reason behind the study findings, is that SA is a collectivist country, entailing that children may be inclined to following instructions and obeying adults, hence they performed well on the task, due to their compliant abilities. However, additional research in low middle income countries is needed. This is in light of the fact that these countries are not often the focus of the research, thus they need to be explored more to gain a more comprehensive understanding of how varying factors, such as culture and SES for example, influence development and processes such as EF (Howard et al., 2020; Sakshi, 2021). Moreover, these results are in contrast to the study explored above, hence, the association between SES and EF are unclear.

SA is a country with a high prevalence of risk-taking behaviour. That is, contributors to risky behaviours such as poverty and unemployment, as well as risk-taking behaviours, such as crime, violence and alcohol consumption are common among South African youth (de Jager & Naudé, 2018). Therefore, de Jager and colleagues (2018) investigated the extent to which these context-based factors influence risk-taking behaviours. Their sample comprised of 194 Black adolescents, aged between 16 and 19, located in the rural areas of Free State. The self-reported measures which they utilised indicated that males are more prone to risky behaviour in comparison to females. Moreover, the more time adolescents spend with their peers, the more likely they are to engage in risky behaviours. This is relevant as group related activities, such as gang violence, alcohol consumption and other peer pressure influences are common in SA. However, the results further indicated that when parents are involved with their children and monitor their children, their children are less likely to engage in risky behaviours. Since non-nuclear families are common in SA, it is possible that the lack of parent involvement can lead to risky behaviours.

2.4 Research Question and Aims

Taken together, the primary research question for this study was:

What is the relationship with SES and EF, specifically inhibitory control and working memory, on risk-taking behaviours in a sample of South African adults?

The primary aim of the study was therefore to investigate how SES was associated with EF, specifically inhibitory control and WM, and how these associations may influence risk-taking behaviour. To answer this larger aim and research question the study consisted of multiple sub-aims:

1. To create a comprehensive measure of SES, using both objective and subjective measures. These include parental education and household assets as objective ratings, and subjective financial ratings.
2. To determine the neurocognitive profile on EF, specifically inhibitory control and working memory, in this sample and investigate the relationship between EF on the above measures of SES.
3. To investigate the degree of risk-taking behaviour in this sample of South African adults and explore the relationship between risk-taking, EF, and SES.

Based on the studies explored above, the association between EF, SES and risk taking is unclear. Some studies support the notion that high SES fosters greater EF performance (St John et al., 2019) and further fosters less risk-taking behaviours. However, some studies have found contrasting results (de Jager & Naudé, 2018; Howard et al., 2020). Therefore, the hypothesis for the study was that an association between EF, SES and risk-taking behaviour was present, however, the directionality and strength of the association would be determined from the study's findings. In accordance with the SMH, it was hypothesised that participants' performance in the IGT would improve as they progress with the task. In particular, participants were expected to initially be guided by their emotional abilities and hot EF, however as their familiarity of the options and outcomes increased, their decision-making would be guided by their cognitive abilities and cold EF factors. This would result in a positive change in decision and consequently less risk-taking behaviours would be observed.

Chapter 3: Research Methods

3.1 Research Design

The research was part of a larger study which was aimed at exploring the relationship between demographic factors and the performance in cognitive tests: exploring the mediating power of speed of processing. As such, the current research was aimed at identifying how SES was associated with EF, particularly inhibitory control and working memory, and how this association influenced risk-taking behaviour. Primary data was utilised to explore these associations. The study was quantitative in nature, specifically, cross-sectional and adopted a non-experimental design (Queirós et al., 2017). There was no manipulation of the independent variables, EF, and SES, no experimental or control groups and no random assignment present. Therefore, the study followed an ex-post facto design.

3.2 Sampling and Response Rate

The research adopted a non-probability, volunteer-based, sampling strategy. As such, participants were recruited through a convenience and snowballing sampling. The sample was recruited from a healthy population and participants were recruited from the Johannesburg, Limpopo, and Kwa-Zule Natal provinces in South Africa. To advertise the research and reach potential participants, a research study poster was created and circulated by the researcher on social media platforms, such as Instagram, WhatsApp, and LinkedIn. Thereafter, individuals from the population further circulated the advert on these platforms, which accounted for the snowballing aspect of sampling. A total of 100 participants were collectively recruited by four researchers' that fell part of the larger research project. As such, the target sample was met. All participants were compensated for transportation costs and thus was provided R90-00. To be eligible to participate in the study, all participants were between the ages of 18 and 60 and were able to speak and comprehend English as the research was conducted in English. Additionally, individuals with neurological impairments, deficits in EF, were on chronic medication as well as individuals who had a history of substance abuse and addictions, and a history of loss of consciousness was not eligible to participate. This was to ensure that major illnesses that potentially affected the brain were excluded and that the target sample of a healthy population was obtained.

3.3 Instruments

3.3.1 Demographics Questionnaire and SES Measures

Firstly, participants completed a demographic questionnaire (Appendix C), which was administered using the pen-paper method. As the study formed part of a larger study, as described above, not all questions composed in the demographic questionnaire were used for this study. The questions and measures that were used are explored below.

Demographic data was collected regarding the participant's age, home language, self-identified ethnicity, and educational history. The demographic questionnaire further included detailed questions concerning SES that fell into two categories: objective and subjective measures of SES.

Objective SES are typically obtained through tangible and verifiable indicators, and as such were measured through participant's parent's education and household assets. For parental education, participants had to state both their mother's and father's level of education. As per appendix C, the levels provided included, no schooling, less than primary school completed, primary school completed, secondary school not completed, secondary school completed, tertiary education completed, and other. In addition, the Living Standard Measure (LSM), developed by the South African Advertising Research Foundation (SAARF, 2011), was used to measure household assets. Participants were provided with a list of household assets and amenities and were required to tick the boxes of the assets and amenities that were present in their household, such as running water, electricity, computer, home security service, and electric stove to name a few. To score the LSM measure, a weighted score is provided for each asset/amenity, hence a total score was calculated by adding the weighted score for each item that a participant marked as 'true'. Thereafter, a raw score was calculated by subtracting a constant of -0.81052 from the total score. This resulted in a final LSM score which ranged between 1 to 10, whereby higher LSM scores indicated higher standards of living.

Subjective SES ratings are understood as self-perceptions of SES (Weissberger et al., 2022). Participants reported their perceptions of their SES and this was measured by their household financial situation, income comparison of their community, and subjective financial standing (Tuberville et al., 2019; Weissberger et al., 2022). Together these three questionnaires are referred to as fiscal appraisal and were developed by Tuberville et al. (2019) that have already been validated for a South African context. For the household financial situation measure, participants were required to rate their household financial situation on a 5-point scale, whereby

1 was much above the average income, 3 was an average income, and 5 was much below the average income. Similarly, the income comparison of their community measure required participants to rate their household income in comparison to households in their community. This was measured on a 5-point scale, whereby 1 was very comfortable, 3 was comfortable, and 5 was extremely poor. For both measures, higher scores were indicative of low financial situations both within the household and in comparison with their community. Lastly, for the subjective financial standing measure, participants were to imagine a ten-step ladder where the poorest people in SA stood on the bottom (the first step) and the richest people in SA stood on the highest step (the tenth step). Participants were to state which step they were on. This was measured on a 10-point scale, whereby higher scores indicated a higher financial standing.

3.3.2 Iowa Gambling Task

The Iowa Gambling Task (IGT) was originally developed to identify decision making deficits among individuals with damage to the ventromedial PFC. Hence, the function of the IGT was to measure decision making capacity (Steingroever et al., 2013). Furthermore, as Steingroever and colleagues (2013) state, the IGT was a widely used measure among the clinical population with decision making deficits. Additionally, it was used on a variety of clinical populations including individuals with pathological gambling problems, obsessive-compulsive disorders, psychopathic tendencies, and schizophrenia. It was further widely used on non-clinical populations, such as cocaine addicts, traffic offenders and prison inmates. More recently, the IGT, as a now validated and standardised experimental protocol is also used to assess risk-taking behaviours, that fall part of decision-making processes, in healthy individuals (Barnhart & Buelow, 2022). As such, the IGT was the main measure for risk-taking behaviour in this study.

In the IGT, participants are given $2000 of facsimile monetary notes, and four decks of cards, consistent in terms of size and appearance, are placed in front of them. The participants are then instructed to select one card at a time from any deck. Based on the card they select, participants either gain additional money or are required to pay a certain amount through a penalty from their facsimile money, however, the end goal of the task was to maximise their profits (Bechara et al., 1994). The four decks, as Bechara (1994) explains, are referred to as Deck A to D. Selecting a card from Deck A or B would gain the participant $100, whereas only $50 would be gained from selecting Deck C or D. However, the future consequence of each deck varies, as the former two decks would have a higher penalty in comparison to Deck C and D. For instance, upon selecting 10 cards from Deck A, a participant would earn $1000 but upon

selecting these cards, they would further face 5 unpredicted penalties, which would result in them being required to pay a total penalty cost of $1250. This indicated that upon selecting cards of higher monetary value, the participant actually incurred a loss of $250. In contrast, if a participant would select 10 cards of Deck C, a total of $500 would be gained with a total penalty payment of $250, resulting in a profit of $250. Therefore, Deck A and B were disadvantageous as they would lead to large immediate gains but consequently would result in a loss. On the other hand, Deck C and D were advantageous as it would lead to a future profit.

In this study, the IGT was administered digitally and offline. The IGT was acquired using an open access, PsyToolkit, platform for psychological tools which allows users to demonstrate, program, and run cognitive-psychological experiments and surveys (https://www.psytoolkit.org/) - and could be used offline or online. The offline version of the task was used on a charged laptop to make it more accessible to a South African population that might not have access to electricity or internet in certain locations or during scheduled electricity cuts. The participants were presented with a laptop and provided with detailed instructions on the task. It was further instructed that in the task, they were required to play a 'gambling' game. To play they chose one of 4 buttons (A, B, C, D) with the mouse/ trackpad. They were further informed that each time, they could win some money, but sometimes they had to pay a fee to the bank. After each trial, they collected the money, which adjusted the sum of their money. Each participant began with a loan of R2000 (facsimile money) and 'gambled' on 100 trials.

The long-term consequences (LTC) index was adopted to score each participant's performance on the IGT. According to this index, participants gamble for long stakes and consequently tend to choose advantageous decks. This implies that participants are intelligible of the term long effects of the decks. As a result, participants are inclined to choose advantageous decks, implying that they are risk aversive (Burdick et al., 2013). To obtain the LTC score, the sum of the advantageous decks was subtracted from the sum of the disadvantageous deck. This was mathematically represented as LTC = [(C+D) - (A+B)], whereby the letters represented the respective decks (Barnhart & Buelow, 2022; Burdick et al., 2013). This formula resulted in either a positive or negative score for each participant. As such, a positive LTC score indicated an advantageous decision, implying a risk averse individual, whereas a negative LTC score indicated a disadvantageous decision, implying a risk-taking individual (Barnhart & Buelow, 2022).

Moreover, to explore the change in decision-making across the100 trials, the trials were divided into 5 blocks. Block 1 consisted of trials 1-20, block 2 of trials 21-40, block 3 of trials 41-60, block 4 of trials 61-80, and block 5 of trials 81-100. The LTC formula was used to calculate a score for each block and similarly, positive scores indicated risk-aversive and negative scores indicated risk-takers. This was carried out to measure decision-making under ambiguity and risk. It has been shown that participants make decisions under ambiguity during the first two blocks and decisions under risk for the last three blocks. The understanding, as explained by Ouerchefani et al. (2019) is that in the beginning of the IGT, participants are unaware of the outcomes of the decks and must implicitly learn the general pattern. However, as they become explicitly familiar with the decks and the pattern, they can predict the outcomes of the decks and perform under risk.

Additionally, the IGT was divided into the five blocks to further measure the potential employment of hot and cold cognitive factors during the task. With regards to the IGT, it is argued that initially hot EF is adopted as individuals are guided by their 'gut feeling', however, as they progress with gambling game, their cognition comes into effect (Chiu et al., 2018; Colautti et al., 2022). As mentioned above, the first two blocks of the IGT are decision-making under ambiguity which is further when hot EFs is in operation as the strategy for the task has not yet been developed and participants are guided by their emotion. Thereafter, during decision-making under risk, as categorised by the last three blocks of the IGT, cold EFs are operationalised as participants are aware of the outcomes of the decks. Particularly, participants are to remember the deck choices and inhibit selections from disadvantageous decks (Ouerchefani et al., 2019). Hot functions were not assessed in the current study because the study focused heavily on cognitive aspects.

3.3.3 The Wechsler Digit Span

The Wechsler Digit Span Test which is a subset of the Wechsler Adult Intelligence test, was administered to measure WM. In particular, the DSF, DSB, DSS and Number-Letter Sequencing was administered.

To administer the DSF, a number sequence was orally stated with the number sequence becoming progressively longer after two trials. After each sequence presented, the participant repeated the number sequence back to the researcher in the same order. If the participant made two errors on a trial, the test was discontinued. The DSF is known to exhibit good internal consistency, with a reliability coefficient typically around 0.80 (Wechsler. 2009). For the DSB,

a number sequence was orally stated with the number sequence becoming progressively longer after two trials. After each sequence presented, the participant repeated the number sequence in the reverse order. If the participant made two errors on a trial, the test was discontinued (Leung et al., 2011). The DSB also shows good internal consistency, with reliability coefficients around 0.75–0.80, reflecting its slightly higher cognitive demand compared to DSF. In the DSS, a sequence of numbers was orally stated with the number sequence becoming progressively longer after two trials. After each sequence presented, the participant stated the sequence of numbers in chronological order. If the participant made two errors on a trial, the test was discontinued. The DSS tends to have slightly lower internal consistency than DSF and DSB, with coefficients around 0.70–0.75, due to its additional complexity.

The score was determined based on the number of correct responses on each trial. As such for every correct sequence, the participant received a score. At the end, the scores were tallied, and each participant had a score out of 16 for the DSF, DSB, and DSS. A digit span total score out of 48 was provided by summing the score of each part. Moreover, since the sequences got progressively longer, the longest correct sequence was recorded as well. These were recorded as the Longest Digit Span Forwards (LDSF), Longest Digit Span Backwards (LDSB), and Longest Digit Span Sequencing (LDSS) High scores were indicative of good auditory short-term memory as well as excellent attention. In contrast, low scores were interpreted as the participant having difficulty in terms of concentration (Groth-Marnet & Baker, 2003). The test was administered using the paper-pencil method.

The Digit Span tasks, particularly the DSB and DSS, have demonstrated strong construct validity, being recognised as valid measures of WM, with DSB and DSS involving more complex executive processes than DSF. Additionally, these tasks correlate well with other measures of working memory and attention, further supporting their convergent validity (Groth-Marnat & Baker, 2003).

3.3.4 Stroop Colour and Word Test

The Stroop test was developed in 1935 by John Ridley Stroop. Since its development, there have been multiple variations of the test, however, a standardised version is lacking (Jensen, 1965). Nevertheless, the Stroop Test measures the ability to inhibit cognitive interference. This interference is said to occur when processing the stimulus of a factor affects the processing of the same stimulus with a different attribute. This processing occurs simultaneously (Scarpina & Tagini, 2017).

The Stroop Test is known for its robust psychometric properties. The reliability of the Stroop Test has been well-documented, with studies reporting high test-retest reliability coefficients ranging from 0.80 to 0.90, indicating the consistency of the test results over time. Additionally, internal consistency for the Stroop Test is also strong, with Cronbach's alpha values often exceeding 0.80, particularly for the interference condition, which is the most cognitively demanding task (Golden & Freshwater, 2002).

The test has also been shown to have strong validity. Construct validity is supported by the fact that performance on the Stroop Test correlates well with other measures of EF, particularly those assessing inhibitory control and attention (Scarpina & Tagini, 2017). The test's criterion validity is demonstrated by its ability to distinguish between individuals with and without cognitive impairments, such as in cases of neurological disorders, where those affected typically show poorer performance (Golden & Freshwater, 2002).

The Stroop consisted of three varying components and each component was administered using the pen-paper method. For the initial component, the participant was instructed to simply read the names of colours that were printed in black ink. This was referred to as words (W). In the next stage, called colour patches (C), participants were instructed to name the colours denoted by 'XXXX'. Each 'XXXX' was presented in either the colour blue, red, or green and the participant simply read out the colour. In the final stage, colour-word (CW), the name of a colour was printed in a contradictory colour (i.e., the word 'RED' was printed in a red, green or blue colour) whereby the participant was instructed to read out the colour of the ink and not the colour word. This stage was the inhibition stage as participants were required to perform a less automatic task, such as naming the colour ink, while they simultaneously inhibited the interference of a more automatic task, such as naming the colour word (Jensen, 1965; Scarpina & Tagini, 2017). For each stage, the participant was given 45 seconds to read out what was required as quickly as possible with minimal errors.

To score the Stroop, the total number of correct responses, which were the raw scores, and error rates was recorded for the W, C, and CW phase. An interference score was calculated for the Stroop to measure a participant's level of inhibition. This was created using the formula, Interference Score = CW[(W*C)/(W+C)] (Scarpina & Tagini, 2017). Based on this interference score and as discussed by Scarpina and Tagini, high scores were indicative of a good ability to inhibit interferences, whereas lower scores indicated a weaker ability to inhibit interferences. In this case, the interference is the word printed in incongruent ink as participants must suppress

the act of reading out the colour word and instead read out the colour of the ink which the colour word is printed in. Thus, the ability to inhibit interferences shows good inhibitory control.

3.4 Research Procedure

3.4.1 Equipment and Software

As participants volunteered to participate in the research, the researcher provided brief additional information regarding research participation. This included that participation was to be conducted face-to-face and that the completion of the cognitive assessment was required. Once participants were comfortable with participation, the researcher provided each participant with a link to schedule a booking to participate in the research. This booking was completed on an online platform and the confirmation was sent through email. Based on the location of participants, assessments were administered either at the University of Witwatersrand, after permission was obtained (Appendix G & F) or in a private setting in the Johannesburg area. Assessments were administered in a private, quiet, and one-to-one session in both locations. This ensured a degree of standardisation across the two locations.

The demographic questionnaire together with the cognitive tasks, namely the Wechsler Digit Span and the Stroop Colour and Word Test, were administered through the traditional pen and paper method. The required stationery required for each assessment was provided to each participant by the researcher. The IGT was the only assessment that was administered digitally. The digital IGT was retrieved from PsyToolkit and participants completed the offline version of the task on the researcher's laptop. When data was collected after each participant, the response documents were stored in a locked cabinet at the University of Witwatersrand. The IGT responses were stored on the researcher's laptop and a OneDrive folder; both were password protected.

3.4.2 Session Protocol

At the start of each administration session, each participant was provided with a participation information sheet (Appendix B). The researcher verbally explained the purpose of the study, the requirements of the participants, and further addressed any questions or concerns raised by the participant. Thereafter, informed consent was provided to obtain the participant's consent to partake in the research and this form was signed by both the participant and researcher (Appendix A). As participants were reimbursed, each participant was provided

with two forms, in which they provided their banking details and acknowledged the payment, respectively. Thereafter the administration process began.

The researcher was trained to administer each of the assessments. This training was completed under a registered psychometrist and current PhD student from the University of Witwatersrand. Thereafter, a research supervisor, registered neuropsychologist and senior lecturer at the university, tested the researcher's administration skills. Administration was carried out in English for all the participants and the identical instructions of each assessment were verbally presented to all participants. These measures ensured that standardisation of the data collection process was maintained. The assessments began with the completion of a demographic questionnaire. Thereafter, the assessment order for each participant was as follows: DSF, DSB, DSS, Letter-Number Sequencing, digital IGT, and The Stroop Colour and Word Test.

3.5 Statistical Analysis

Once the data had been collected, the data entry and scoring were cross-checked by members of the research team to ensure that the data was clean. Upon this cross-check, it was found that four participants reported chronic illness. Since the exclusion criteria were that participants should not present with any chronic, psychological, or neurological illness, these four participants were removed from the final dataset and consequently were not included in the analysis. Thus, only 96 participants were included in the analysis, which constitutes a sufficient sample size to conduct a Pearson's correlation, ANOVA, and multiple regression. Once, the data was cleaned, it was analysed using the statistical software, IBM SPSS 28 (IMB Corp., 2023). For all analyses a p-value of 0.05 was used to determine statistical significance.

3.5.1 Demographic Data

The demographic questionnaire required participants to report on their age, gender, self-identified ethnicity, home language, their years of education, if they failed grade, and how many grades they had failed. The responses for gender, self-identified ethnicity, and home language were numerically coded. The years of education were categorised into three categories, namely less than 12 years of education, 12 years of education, and more than 12 years of education. Based on the South African schooling system, 12 years of education is indicative of completing formal school, from preschool until grade 12. More than 12 years of education represents individuals who receive higher levels of education and training, through the attendance of universities, colleges, and alternate career training. Next, participants

reported if they failed a grade in school as well as the number of grades failed. These were provided with numerical codes as well. Once, the demographic data was coded and entered into SPSS, each variable was standardised in terms of variable levels and each coded variable was provided with value labels. Thereafter, descriptive statistics, namely means and standard deviations, and frequencies analysis were run.

3.5.2 SES

The measures used to capture the potential SES of participants included the participant's mother's and father's level of education, assets as measured by the LSM, household financial situation, income comparison of their community, and subjective financial standing. A comprehensive measure of objective and subjective SES ratings was created using these measures. The objective measures consisted of the parental education and household assets, whereas the ratings of the household financial situation, income comparison of their community, and subjective financial standing encompassed the subjective measure.

The analyses of both objective and subjective SES were simultaneously analysed. Codes were provided for the household financial situation and income comparison with the community scores. The parent's level of education was transformed into a continuous variable by categorising each level as follows: no schooling, less than 7 years of schooling, 7 years of schooling, less than 12 years of schooling, 12 years of schooling, more than 12 years of schooling, and other. Thereafter, descriptive statistics, namely means and standard deviation, and frequencies were conducted on all SES measures.

A Pearson's correlation was conducted to determine the relationship between the objective and subjective SES measures. Before performing the analysis, key assumptions were assessed and confirmed. These assumptions include the linearity of the relationship between the two variables, the absence of significant outliers, and the normality of the distribution of both SES measures. The linearity assumption was verified through a scatterplot, which showed a roughly straight-line relationship between the variables. Outliers were checked and found to be minimal, ensuring they did not distort the correlation. Normality was assessed using a Shapiro-Wilk test and normal probability plots, both of which indicated that the data were approximately normally distributed. Lastly, reliability analysis was conducted to determine the extent to which the objective and subjective SES measures were consistently measuring SES.

3.5.3 Risk-Taking

The digital task, the IGT, assessed risk-taking behaviours among the participants. Prior to running the analysis, the IGT net score was calculated for each participant, with the formula, LTC = [(C+D) - (A+B)]. The sum of the advantageous decks was subtracted from the sum of the disadvantageous decks. Thereafter, to explore the cognitive and affective factors of decision making, the total 100 trials of the IGT was divided into 5 blocks, i.e. block 1= trial 1-20, block 2 = trial 21-40, block 3= trial 41-60, block 4= trial 61-80, and block 5= trial 81-100. The same LTC formula was carried out to obtain the participant's score for each block. For both the overall and block scores, higher scores implied risk aversive whereas lower scores implied risk-takers. As such, descriptive statistics, namely means and standard deviation was conducted on the net scores.

3.5.3.1 ANOVA Analysis

A repeated measures ANOVA was conducted on the IGT block scores to assess changes in decision-making during the IGT experimental task. Prior to running the ANOVA, key assumptions were evaluated to ensure the validity of the analysis. The assumption of normality was checked for each IGT block score by examining skewness and kurtosis. Skewness values fell within the range of -0.5 to +0.5, and kurtosis values ranged between -1.0 and +1.0, indicating that the distribution of scores was approximately normal. The assumption of sphericity, which is crucial for repeated measures ANOVA, was assessed using Mauchly's Test of Sphericity. The test result was not significant, X^2 (9) = 11.56, p = .239, indicating that the sphericity assumption was met. With all assumptions satisfied, the repeated measures ANOVA was performed, providing a valid analysis of the changes in decision-making across the IGT blocks.

3.5.4 Executive Function

Inhibitory Control

As a measure of inhibition, the Stroop Colour Word Test was used. The Stroop test consisted of 3 parts, namely W, C, and CW. As discussed above, for the first two parts, the participant was required to read out as many words. In the final part the participant had to ignore the word of the colour and read out the colour of ink that the word was written in, which was incongruent to the word. This measured inhibition. To measure the ability to inhibit interferences, the Stroop Interference Score was calculated and used for analyses.

Working Memory

As a measure of WM, the Wechsler Digit Span was used. The digit span consisted of the DSF, DSB and DSS. For each part, the participant had to verbally repeat a sequence of numbers in the same order (DSF), reverse order (DSB), and in a sequential order (DSS). The score for each part is the number of correct responses. Since the DSB is a more accurate measure of WM in particular, only the DSB scores were included in the regression models of analysis.

The Stroop Colour and Word Test and the Digit Span was analysed by running descriptive statistics to obtain means and standard deviations. A Pearson's correlation was further conducted to determine if the measures were correlated.

3.5.5 Multiple Regression Analysis

A series of multiple regressions were conducted to identify the association between the variables. As a measure of EF, only the DSB and Stroop Interference scores were utilised in all regression models. The DSB is the executive component of WM as it requires participants to mentally store the information while simultaneously manipulating and reorganising it. Hence, only the DSB was included in the regression analysis. Since the final part of the Stroop Colour and Word Test was focused on inhibitory control, only the Stroop Interference Score, as a measure of inhibition, was included in the regression analysis.

All assumption analysis was conducted and checked prior to running the final regression analysis. The predictor variable-SES measures- and criterion variables, namely Stroop Interference Score, DSB, and IGT were all measured on a continuous level. Since the participants were assessed only once, independence of observation was assumed. Based on a scatterplot graph, a linear relationship between the criterion variable and each predictor variable, and between the criterion variable and the predictor variables collectively were present. A scatter plot confirmed that the data showed homoscedasticity. The data did not show multicollinearity as all correlations were less than 0.8, tolerance values were greater than 0.2, and the VIF statistics were all should be less than 10. Outliers were identified using Cook's D, Mahalanobis' Distance, Centred Leverage, and standardised residuals. If the minimum and maximum values of the standardised residuals were greater than -3 and 3, respectively, outliers were considered present. Participants with values exceeding the calculated Cook's D, Mahalanobis' Distance and Centred Leverage thresholds were excluded. Since this was not the case, no outliers were removed. Lastly, as per histograms and standardised residuals, residuals (errors) were approximately normally distributed.

Three multiple regression models were conducted. Model 1 tested if SES predicted EF. This was divided into model 1A which tested SES and inhibitory control, and model 1B which tested SES and WM. Model 2 tested if EF predicted risk-taking behaviours, and model 3 tested if SES and EF predicted risk-taking behaviour. The above assumptions were met for all three regression models.

3.6 Ethical Consideration

Ethical clearance was obtained from the Human Research Ethics Committee (Non-Medical) of the University of Witwatersrand, with the protocol number MAPSYC/23/05 (Appendix E). The data collection only began once ethical approval was obtained. The researcher completed ethical training through the Department of Psychology and through external training (Appendix D).

As per the participant information sheet (Appendix B) prior to testing the participants, the researcher verbally explained the purpose of the study to each participant as well as what was required of them. Informed written consent was obtained from each of the participants (Appendix A). Participants were further made aware that they have the right to withdraw from study at any point and were informed about the R90-00 reimbursement. Furthermore, to ensure the anonymity of participants, data was collected in an enclosed space during an individual setting, hence, participants were not aware of each other as each participant had their own individual assessment session. Although the collected data was used by other researchers who were part of the larger project, each participant was allocated a participant number, hence no identifiable information was included in the analysis or reporting of results. Thereafter, once the data was collected, it was stored on a secure and password protected laptop and the data of each participant was stored in a manner that was compliant with the Protection of Personal Information Act (POPI) and was therefore fully anonymised. The physical documents were anonymised and kept in a secure and locked location.

Chapter 4: Results

4.1. Demographic Characteristics

Demographic data captured participant's age, gender, ethnicity, home language, years of education, grade failure and frequency of failed grades. As seen in Table 1 below, the final sample comprised of 96 participants. As per the frequency table (Appendix H), the sample consisted mainly of females (64), with only 32 males. Hence, females were slightly overrepresented in the current sample. In terms of age, participants were between the ages of 18 and 60, with an average age of 32.21 (SD: 9.95) years. This indicated that the sample was relatively young in age, yet it captured a wide age group, resulting in different cognitive maturation levels among participants. Moreover, the common South African ethnic categories- African, White, Indian, Coloured- were used. Within the sample, 78.1% participants self-identified as African, 18.8% as Indian, 2.1% as White, and 1% as Coloured. In terms of home language, 54.2% of the participants reported that they spoke IsiZulu, 21.9% participants spoke English, another 21.9% spoke Sepedi, and 2.1% of participants reported an 'Other' language (Appendix H). Since there is a mixture of different self-identified ethnicities and spoken home language, the sample was relatively diverse as participants were from different backgrounds. In rating their highest level of education, 47.9% of participants had 12 years of education, 36.5% had more than 12 years of education, and 15.6% had less than 12 years of education. However, in terms of number of grades failed, 24 participants reported having failed at least 1 grade throughout their schooling years, whereas 8 participants failed 2 years (Appendix H). Nevertheless, all participants had received formal education, with most of the participants being well educated as they had completed their schooling education and some further their studies after completing the standard 12 years of education.

Table 1: Sociodemographic Characteristics of the Sample

Variables	*n*	*%*	*M*	*SD*	*Range*
Total	96	-	-	-	-
Age	96	-	32.21	9.95	18-60
Gender					
Female	64	66.7	-	-	-
Male	32	33.3	-	-	-
Ethnicity					
African	75	78.1	-	-	-
Indian	18	18.8	-	-	-
White	2	2.1	-	-	-
Coloured	1	1.0	-	-	-
Home Language					
IsiZulu	52	54.2	-	-	-

English	21	21.9	-	-	-
Sepedi	21	21.9	-	-	-
Other	2	2.1	-	-	-
YoE					
Less than 12 YoE	15	15.6	-	-	-
12 YoE	46	47.9	-	-	-
More than 12 YoE	35	36.5	-	-	-
Grade Failed					
Yes	33	34.4	-	-	-
No	63	65.6	-	-	-
Number of Years Failed					
Never	63	65.6	-	-	-
1 year	24	25	-	-	-
2 years	8	8.3	-	-	-

YoE=Years of education

4.2 SES

Aligned to one of the sub-aims of the study, a comprehensive measure of SES was created to include objective and subjective measures. The objective measures were parental education and possession of assets in the household (LSM scores). The subjective measures included ratings of the household financial situation, income comparison community, and subjective financial standing.

4.2.1 Objective SES

The objective SES of participants were measured by parent's education and household assets. The results indicated that mother's level of education had a mean and SD of 4.43 (1.47), whereas father's level of education had a mean and SD of 4.44 (1.57). This indicated that on average, participants reported their parent's education levels as falling between 'less than 12 years of education' and '12 years of education'. As per the mother's level of education results (Appendix H), and illustrated in Figure 1, 6.3% had no schooling, 7.3% had less than 7 years of schooling, another 7.3% had 7 years of schooling, 19.8 % had less than 12 years of schooling, 35.4% completed 12 years of schooling, 20.8% had more than 12 years of schooling, and 2.1% had 'other'. Based on the father's level of education on Appendix H and Figure 1, no schooling and less than 7 years of schooling was accounted by 6.3% each, 7 years of schooling and less than 12 years of schooling both had a result of 12.5%, 31% of fathers had 12 years of schooling, 18.8% had more than 12 years of schooling, and 5.2% had other. This highlighted that mother's had a higher level of education than fathers. Nevertheless, most of the parents had completed their basic level of education and had a higher level of education.

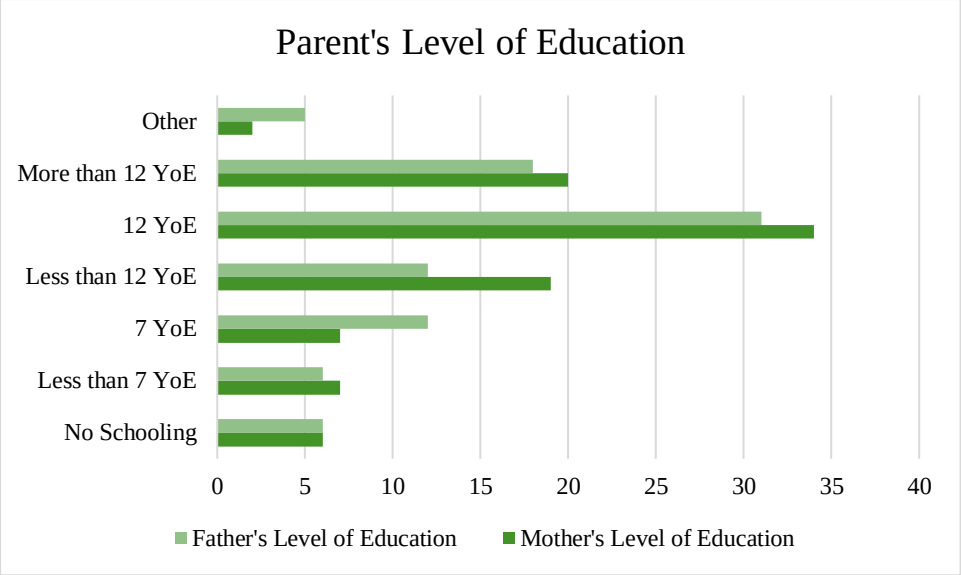


Figure 1: Distribution of Parents' Level of Education

The LSM measure had a mean and standard deviation of 8.60 (1.43). This showed that on average, participants belonged to the 8th LSM category, placing participants on the higher continuum of SES. As illustrated in Figure 2 below, no participants fell into the LSM category of 1 to 4. Specifically, 35.4% participants had a LSM score of 10, 28.1% had a score of 9, 11.5% had 8, 12.5% had 7, 11.5% had 6, and only 1% had a score of 5 (Appendix H). Based on these LSM results, the participants were classified as having a high standard of living.

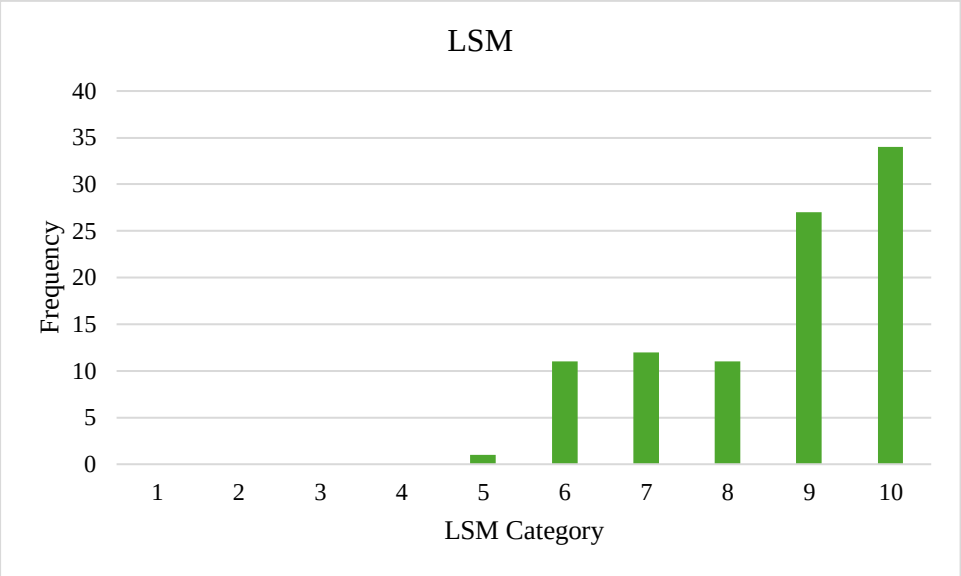


Figure 2: Frequency of LSM Category

4.2.1 Subjective SES

The subjective SES of participants were measured by ratings of household financial situation, income comparison of their community, and subjective financial standing. Based on descriptive statistics, the mean for household financial situation was 3.10 (SD=0.92). This indicated that an average number of participants rated their household financial income as slightly above average. The income comparison community rating yielded a mean of 2.97 (SD= 0.69), indicating that on average, participants reported feeling slightly above comfortable when rating their household income in comparison to their community. The subjective financial standing mean was 4.67 (SD=1.60). This suggested that on average, participants perceived themselves to be slightly below the midpoint of the SES continuum in SA.

In terms of frequencies (Appendix H), and as represented by Figure 3, 58.3% of participants rated their household financial situation as average, 3.1% and 16.7% as much above the average and above the average, respectively, 10.4% rated it as below the average, and 11% as much below the average. In rating their household in relation to their community, 71.9% reported that their household is comfortable, 10.4% was above comfortable, 4.2% was very comfortable, 11.5% was below comfortable, and 2.1% rated their household as extremely poor (Appendix H). When asked to rate their subjective financial standing (Appendix H), 34 participants rated it between 1 and 4, 36 rated it as a 5, and 25 rated it between 6 and 10. Taken together, these results indicate that the majority of participants subjectively viewed their SES as average.

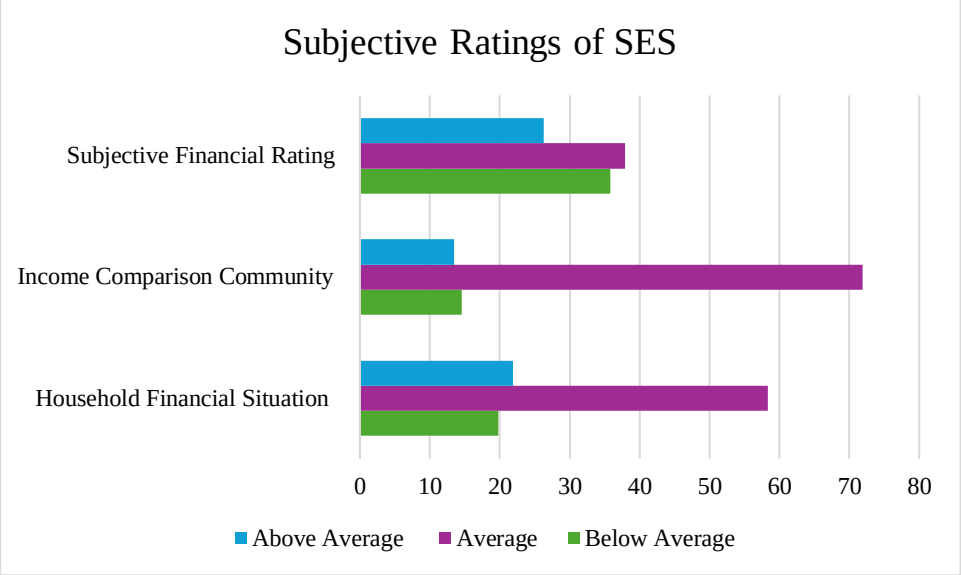


Figure 3: Responses on the Subjective Ratings of SES. For illustration purposes, scores were converted to percentages and categorised into below average, average, and above average.

In comparing the objective and subjective SES results, the results alluded to the fact that objective SES results placed them in a higher SES bracket, whereas participants perceived themselves as belonging to an average SES bracket.

4.2.3 Correlational Results of SES Measures

A Pearson's correlation was conducted to determine if the SES measures were correlated with each other. Based on Table 2 below, the three subjective SES measures, namely household financial situation, income comparison community, and subjective financial standing were all correlated. Specifically, income comparison community was significantly correlated to household financial situation, r (96) = (.403), p = < .001, although this was a low positive correlation. Subjective financial standing was significantly correlated to both household financial situation and income comparison community, r (95) = (-.398), p = < .001 and r (95) = (-.356), p = < .001, respectively. This shows a low negative correlation, implying an inverse correlation whereby as participant's ratings on the subjective financial standing measure increased, their ratings on their household financial situation and income comparison community decreased and vice versa. Despite LSM being an objective SES measure, it was significantly correlated with income comparison community and subjective financial standing, r (96) = (-.335), p = < .001 and r (95) = (.456), p = < .001, respectively. This shows that LSM was low and negatively correlated with the former, such that as the LSM score increased, the income comparison community rating decreased and vice versa. The LSM was low and positively correlated with subjective financial standing. Furthermore, the LSM

significantly correlated with mother's years of education r (95) = (.366), p = < .001, but not father's years of education. This was a low positive correlation. Lastly, father's years of education was significantly correlated with mother's level of education, r (90) = (.674), p = < .001. This is the only moderate correlation. Overall, these correlations indicate that subjective measures of SES are more correlated with each other as opposed to correlations among objective measures.

Table 2: Pearson's Correlation of SES

			Mother's Level of Education	*Father's Level of Education*	*LSM Total*	*Household Financial Situation*	*Income Comparison Community*	*Subjective Financial Standing*
Objective Measures of SES	*Mother's Level of Education*	*r*	1					
		p						
		n	95					
	Father's Level of Education	*r*	.674	1				
		p	*<.001*					
		n	90	90				
	LSM Total	*r*	.395	.306	1			
		p	*<.001*	.003				
		n	95	90	96			
Subjective Measures of SES	*Household Financial Situation*	*r*	-.244	-.143	-.328	1		
		p	.017	.180	.001			
		n	95	90	96	96		
	Income Comparison Community	*r*	-.206	-.042	-.331	.403	1	
		p	.045	.696	*<.001*	*<.001*		
		n	95	90	96	96	96	
	Subjective Financial Standing	*r*	.323	.248	.443	-.398	-.356	1
		p	.002	.019	*<.001*	*<.001*	*<.001*	
		n	94	89	95	95	95	95

4.2.4 Reliability Results of SES Measures

The reliability of the SES measures was assessed separately for the objective and subjective indicators (Table 3).

The Cronbach's alpha for the three objective SES measures (mother's level of education, father's level of education, and LSM) was α = 0.72, indicating acceptable internal consistency. Further analysis revealed that if the LSM was deleted, the Cronbach's alpha increased to α =.804, suggesting that the reliability of mother's and father's level of education is higher without the LSM.

The Cronbach's alpha for the three subjective SES measures (household financial situation and income comparison community, and subjective financial standing) was found to be α = -0.89. This negative value indicates a problematic scale, likely due to poor or inconsistent responses among the items. Upon further inspection, it was found that if the subjective financial rating was deleted, Cronbach's alpha increased to α = 0.56. While this is still below the acceptable threshold, it represents an improvement in internal consistency. These results are consistent with the correlational results above, which indicated that the subjective financial standing was low and inversely correlated with household financial situation and income comparison community.

These findings suggest that the objective SES measures demonstrated acceptable reliability, particularly when LSM was excluded. In contrast, the subjective SES measures exhibited poor reliability, indicating that the subjective indicators might not consistently measure the same underlying construct, especially when the subjective financial standing was included.

Table 3: Psychometric Properties for SES Measures

		Mean	*SD*	*N*	*Cronbach's α*	*Cronbach's α if Item Deleted*
Objective Measures					.72	
	Mother's Level of Education	4.39	1.49			.43
	Father's Level of Education	4.44	1.57			.52
	LSM Total	1.44	0.94			.80
Subjective Measures					-.890	

Household Financial Situation	3.11	0.93	-.70
Income Comparison Community	2.97	0.69	-1.16
Subjective Financial Standing	4.66	1.60	.56

4.3 Executive Function

To obtain an overall measure of EF, the following were found in terms of inhibitory control and WM.

4.3.1 Inhibitory Control

As a measure of inhibitory control, the Stroop Colour and Word test was administered. The descriptive results indicated that W part had a mean of 83.30 and a standard deviation of 19.34. This implied that on average, participants were able to read approximately 83 words in 45 seconds. The C part had a mean of 57.74 with a standard deviation of 14.52, indicating that on average, participants could read out approximately 57 colours. The last part, CW had a mean and standard deviation of 33.24 and 10.98. This suggested that on average; while engaging in inhibitory control, participants were able to name the ink colour of approximately 33 colour words printed in incongruent ink. The range of correct responses for each part respectively was 25-122, 23-98, and 6-56. This implied that within a 45 second time span, individuals read a minimum of 25 and a maximum of 122 words. In reading colours, the minimum was 23 and the maximum was 98. Lastly, in reading out the colour ink, participants named a minimum of 6 colours and a maximum of 56. Based on these results, performance decreased as participants took longer to name the ink of the colour word as the ink colour and colour word were incongruent. As such, more time was required for the process of inhibitory control. To measure inhibition abilities, the Stroop interference score had a mean of -.59 (SD=7.70). As higher interference scores indicated a good ability to inhibit interferences, this result showed that the current sample exhibited a low ability to inhibit interference in the Stroop task.

4.3.2 Working Memory

The digit span was used as a measure for WM. The DSF had a mean of 9.41 with a standard deviation of 2.50. This indicated that participants had an above average forward WM. The DSB had a mean of 7.05 (SD=2.31) and the DSS had a mean of 7.29 (SD=2.06). In being

able to remember a sequence in reverse order and to be able to organise a sequence in the correct order, these results indicated that participants had an average WM. In terms of the longest correct sequence, the maximum LDSF was 9. LDSB was 8, and LDSS was 8. The longest sequence for each was 9, 8, and 9, respectively. This showed that participants had good working memory for each part.

Based on the Pearson's correlation (Table 3) between the Stroop Colour and Word Test and the Digit Span, CW was significantly correlated with both W, r (94) = (.551), p = < .001, and C, r (94) = (.725), p = < .001. The correlation for both is positive but was a moderate correlation for W and a high correlation for C. Furthermore, the Stroop interference score was significant correlated with only the CW part, r (94) = (.708), p = < .001. This showed that the Stroop interference was high and positively correlated to CW. This implied that as scores on the incongruent trail which measures inhibition (CW), increased, the Stroop Interference Score, which is the ability to inhibit inferences, simultaneously increased. With regards to the Digit Span test, the DSB was significantly correlated with DSF, r (94) = (.402), p = < .001, which was a low positive correlation. The DSS was significantly correlated with DSB, r (94) = (.550), p = < .001, which was a moderate positive correlation. DSF was not significantly correlated with any of the measures. Moreover, the DSB was significantly correlated W, r (94) = (.503), p = < .001 C, r (95) = (.549), p = < .001 and CW, r (94) = (.427), p = < .001. The former two had moderate correlations and the latter had a low correlation. The DSS was significantly correlated W, r (92) = (.472), p = < .001 C, r (93) = (.551), p = < .001 and CW, r (92) = (.471), p = < .001. Here, W and CW had low correlation, and the C had a moderate correlation. The DSB and DSS was not significantly related to the Stroop Interference score.

Table 4: Pearson's Correlation of EF

		W	*C*	*CW*	*Stroop Interference Score*	*DSF*	*DSB*	*DSS*
W	*r*	1						
	p							
	n	94						
C	*r*	.704	1					
	p	*<.001*						
	n	94	95					
CW	*r*	.551	.725	1				
	p	*<.001*	*<.001*					

	n	94	94	94				
Stroop Interference Score	*r*	-.104	.073	.708	1			
	p	.320	.480	*<.001*				
	n	94	95	94	95			
DSF	*r*	.278	.273	.145	-.093	1		
	p	.007	.008	.167	.374			
	n	92	93	92	93	94		
DSB	*r*	.503	.549	.427	-.036	.402	1	
	p	*<.001*	*<.001*	*<.001*	.730	*<.001*		
	n	94	95	94	95	94	96	
DSS	*r*	.472	.551	.471	.099	.232	.550	1
	p	*<.001*	*<.001*	*<.001*	.343	.026	*<.001*	
	n	92	93	92	93	92	94	94

4.4 Risk Taking

The main behavioural task for this study was the IGT, which is a highly validated measure of risk-taking behaviours. The IGT results had a mean of -1.60 and standard deviation of 28.67. This suggested that on average participants exhibited a tendency towards risk-taking behaviours in the IGT. However, based on Pearson's correlation (Appendix I), the IGT block 5 was significantly correlated with the IGT scores across all 100 trials, r (96) = (.812), p = < .001. IGT block 5 was further significantly correlation with block 1: r (96) = (.345), p = < .001; block 2: r (96) = (.489), p = < .001; block 3: r (96) = (.484), p = < .001; and block 4: r (96) = (.521), p = < .001). Together these results indicate a positive association. Based on the r values, the association was low across the first three blocks, but increased to moderate in block 4. Therefore, risk-taking behaviours were stable and consistent for the duration of the IGT task.

The repeated-measures ANOVA determined that IGT scores differed significantly across the five block trials, F (4,380) = 7.67, p <.001. A post hoc pairwise comparison utilised a Bonferroni adjustment (p <.001) for multiple comparisons suggested a significant difference between IGT Block 1, 2, and 5 only. The overall IGT scores demonstrated a significant increase from block 1 (μ=-1.97) to block 2 (μ=-1.46, p <.001), and subsequently increased significantly from block 2 to block 5 (μ=2.44, p <.001). This is illustrated in Figure 4 below. The significant difference observed in blocks 1, 2, and 5 are indicative of a distinct pattern of decision-making behaviour, whereby participants exhibited a change in risk-taking behaviour.

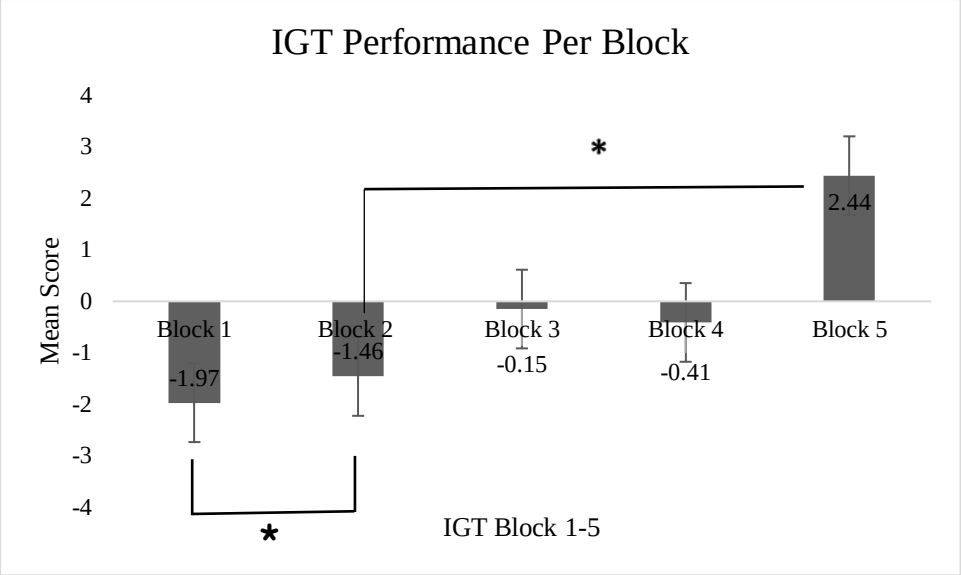


Figure 4: Change in Risk-Taking Behaviour Across the 5 IGT Blocks. There was a significant change in behaviour from block 1 to 2 and from block 2 to 5. There was no significance between block 3 and 4. A negative pattern is present from block 1 to 4 which transforms to positive in block 5.

Additionally, in assessing the association between decision-making and the hot and cold EF, a Pearson's correlation was conducted on the IGT block 1-5, inhibition, and WM (Appendix I). The results did not show a significant correlation between IGT, inhibition, and WM, implying that risk-taking behaviour was not associated with the cold components of EF.

4.5 Multiple Regression

Model 1A and 1B

A multiple regression analysis was conducted to examine the relationship between SES and EF. SES was measured using mother's level of education, father's level of education, household financial rating, income comparison within the community, and subjective financial standing. Inhibitory control and WM were the criterion variables. The model did not significantly predict inhibitory control, F (6,81) =0.43, p=0.85 nor WM, F (6,82) =2.41, p=0.83.

Model 2

A multiple regression analysis was conducted to examine the relationship between EF and risk-taking behaviour. EF was measured using Stroop Interference Score and DSB. Risk-taking behaviour as measured by the IGT was the criterion variable. The model did not significantly predict risk-taking behaviour, F (2,92) =0.75, p=0.48.

Model 3

A multiple regression analysis was conducted to examine the relationship between SES and EF and risk-taking behaviour. SES was measured using mother's level of education, father's level of education, household financial rating, income comparison within the community, and subjective financial standing. EF was measured using Stroop Interference Score and DSB. Risk-taking behaviour as measured by the IGT was the criterion variable. The model did not significantly predict risk-taking behaviour, F (8,79) =0.66, p=0.73.

Taken together, the multiple regression analyses (Table 5) conducted to investigate the relationship between SES and executive functioning, specifically inhibitory control and WM, as well as the potential influence of these variables on risk-taking behaviour, revealed that none of the models were statistically significant. This indicated that the SES variables did not significantly predict inhibitory control, WM, or risk-taking behaviour in this sample. Furthermore, EF, particularly, inhibitory control and WM, did not predict risk-taking behaviours.

Table 5: Summary of Multiple Regression Analysis

	Model 1A			*Model 1B*			*Model 2*			*Model 3*		
Variable	***B***	**SE B**	**β**	***B***	**SE B**	**β**	***B***	**SE B**	**β**	***B***	**SE B**	**β**
Mother's Level of Education	-.76	.78	-.15	.43	.23	.27				-.1	3.09	-.05
Father's Level of Education	.52	.71	.11	-.3	.21	-.2				.91	2.76	.05
LSM	1.12	1.07	.14	.53	.32	.21				-4.67	4.21	-.15
Household Financial Situation	.39	1.01	.05	-.20	.29	-.08				.10	3.88	0.00
Income Comparison Community	.74	1.34	0.7	.82	.39	.25				5.70	5.25	.14
Subjective Financial Standing	.19	.67	.04	.19	.19	.12				2.90	2.56	.16
Stroop Interference							.05	.38	.01	0.00	.43	.00
DSB							1.55	1.28	.13	1.77	1.45	.15

Note: Model 1A: SES predicting Inhibitory Control, Model 1B: SES predicting WM, Model 2: EF predicting Risk-Taking Behaviours, Model 3= SES and EF predicting Risk-Taking Behaviours.

Chapter 5: Discussion

5.1 Discussion in Relation to the Existing Literature

The current study explored the association between SES with EF, specifically inhibitory control and WM, and how this association may influence risk-taking behaviours. The research question that guided the study was, 'What is the relationship with SES and EF, specifically inhibitory control and working memory, on risk-taking behaviours in a sample of South African adults?' As such, the primary aim of the study was to investigate how SES was associated with EF, specifically inhibitory control and WM, and how this association may influence risk-taking behaviour. The sub-aims of the study were to create a comprehensive measure of SES, using both objective and subjective measures. It further aimed to determine the neurocognitive profile of EF, specifically inhibitory control and WM within the sample and to investigate the relationship between EF on these measures. The aim was also to investigate the degree of risk-taking behaviours in the sample of adults in SA and explore the relationship between risk-taking behaviour, EF, specifically inhibitory control and working memory, and SES.

The sample comprised of 96 individuals, aged between 18 and 60, residing in Johannesburg, Limpopo, and KwaZulu Natal. Participants completed both objective and subjective SES measures. Firstly, objective SES was measured through assessing participants' parents' level of education as well as by the LSM which captured the assets and amenities within the household. The LSM indicated that participants were on the higher spectrum of the SES bracket. The subjective measures included ratings of one's household financial situation, their household income in comparison to their community, as well as their perception of their SES standing. In comparison, subjective ratings of SES showed that individuals subjectively perceived themselves as belonging to an average SES bracket. There were further variations within the objective and subjective measures, such that only mother's level of education was associated with father's level of education and the LSM. The father's level of education and LSM were not associated. However, the LSM was significantly associated with two of the subjective ratings, income comparison community and subjective financial rating. It was negatively associated with the income comparison community implying that as the LSM score increased, the income comparison community rating decreased. Parents' level of education was not associated with any of the subjective ratings. The subjective financial rating was significantly associated with the other two subjective ratings, household income and income community. However, this was an inverse association, hence as subjective

financial ratings increased, household financial situation and income comparison community ratings decreased.

The digit span assessment indicated that participants had an overall average WM ability. The DSB was significantly associated with DSF, but this was not the case for DSS. DSS was only associated with DSB. The Stroop Interference score suggests that participants had a low ability of inhibiting interference when engaged in the Stroop task. This score was not significantly associated with any of the other EF measures. The results showed that WM, particularly, DSB and DSS was associated with inhibition as measured on the incongruent part of the Stroop (CW). However, DSF was not associated with any of the inhibition results.

In measuring risk-taking behaviours, the IGT scores implied that participants were relatively more likely to be risk-takers, and this risk-taking behaviour was consistent throughout the task. The ANOVA showed a change in risk-taking behaviours, highlighting the presence of decision-making under ambiguity and under risk. However, the results showed that risk-taking behaviours were not significantly associated with EF, particularly inhibition and WM. Accordingly, these results did not show an adoption of cold EF components.

The study did not find any significant relationship between SES, EF, particularly inhibitory control and WM, and risk-taking behaviours. Hence, SES was not a predictor for EF abilities or risk-taking behaviours. Additionally, EF did not predict risk-taking behaviours.

These results provide novel and greater insights to not only how these factors function on an individual level but also how these functions are collectively associated. This chapter inserts the study results within the broader context of the existing literature pertaining to SES, EF, and risk-taking behaviours.

5.1.1 SES

The study obtained an overview of participants' SES through the use of various SES measures, which were further categorised into objective and subjective measures. Objectively, participants belonged to a higher SES bracket as all LSM scores were five and above. However, participants subjectively viewed their household financial situation as average and their personal financial standing as mostly average and above. These differences provide insights into both the strengths and difficulties associated with measuring SES, which is multifaceted in nature.

Firstly, based on the study's measures, SES can be determined by a combination of monetary value, education, and assets. However, a conventional indicator of one's SES is typically measured, subjectively, by monetary value. Individuals overlook their SES in terms of education and assets which are objectively measured. Hence, the combination of subjective and objective measures is useful as it provides valuable information which cannot be captured in isolation (Zhao et al., 2023). Additionally, an individual's SES is influenced by their subjective financial perspective, their household and education, as well as the financial situation of their community and neighbourhood (Tuberville et al., 2019). Furthermore, responses to subjective measures are mainly based on an individual level, influenced by one's understanding and importance of SES, whereas objective measures are in relation to one's family and household and are often factual and unbiased by understandings or emotional states (Tan et al., 2020). Thus, the adoption of both subjective and objective measures of SES can capture the multiple dimensions impacting upon one's SES and further improves the ecological validity of the responses on these SES measures.

However, a standard measure of SES is not available, and as seen above, SES can be measured from multiple dimensions. Studies may include either subjective or objective measures of SES, whilst others may include both. Different SES indices may be adopted, such as value of income bracket, different assets and amenities, current occupation, number of household incomes, and number of dependents per household to name a few, all of which may place individuals in different SES brackets (Duncan & Magnuson, 2012). In conducting a meta-analysis to examine the association between subjective and objective measures on subjective well-being, Tan et al. (2020) found that the association between subjective SES and subjective well-being was higher than the association between objective SES and subjective well-being. These results, together with the variances found between the objective and subjective association in the current study, emphasises that methodological discrepancies make salient the fact that measuring SES is not straightforward and adoption of different measures and indices yield different results.

Furthermore, the association between subjective and objective measures are not always linear. This was seen in the current study where negative correlations were found between subjective financial standing, household financial situation and income comparison community, as well as with LSM and income comparison community. Moreover, the correlations were mainly low and moderate. On the other hand, the study conducted by Tuberville et al. (2019) was aimed at creating a multidimensional model for economic well-

being. In assessing the association between objective and subjective measures, synonymous as in the current study, a high and positive correlation was found. Similarly, Zhao et al. (2023) study which aimed to compare subjective and objective measures of SES, found that a fair agreement was present among the two measures. The objective and measures were similar to the measures administered in the current study as it comprised of a subjective financial rating ladder as well as an objective measure consisting of the presence of water and sanitation, asset ownership, parents' education, and household income. Therefore, despite the use of similar measures, the association between objective and subjective SES measures differed to the mentioned studies, highlighting potential methodological differences.

5.1.2 Risk Taking Behaviour

The digital IGT task measured risk-taking behaviour. It is argued that the IGT measures real-life decision-making skills within an experimental context. It is argued that healthy participants undertaking the IGT tend to choose more advantageous decks (Deck C and D) and are more likely to yield positive IGT scores as a result of being able to learn the good and bad choices of the task (Steingroever et al., 2013). This is in line with the three assumptions concerning the performance of healthy participants in the IGT. As stated by Steingroever and colleagues, the assumptions are that healthy individuals are able to learn the advantageous and disadvantageous decks; healthy participants show a homogenous pattern of performances and are thus likely to produce similar scores, and lastly that participants examines both advantageous and disadvantageous options and thereafter show a tendency for settling to advantageous choices.

In the current study, the mean of the IGT net score, as calculated by theLTC formula, indicated that most participants were risk-takers. This may further imply that participants made selections mainly from the disadvantageous decks, which go against the common understanding of healthy participants making higher selections on advantageous decks. Hence, the underlying assumptions of healthy participants' performances on the IGT were not met. However, they were met by a study of Bull et al. (2015). Within their study, the 1st experiment investigated the factors, such as individual differences, that may contribute to the differences found in performance of healthy individuals on the IGT. Although Bull and colleagues modified the IGT to include 200 trials instead of the conventional 100, their mean score for the first 100 trials indicated that the healthy participants of their sample were risk aversive as they show preference for the advantageous decks (Decks C and D). Moreover, across the 101-200 trials, performance continued to improve. It is important to note that the

studies differed by age and sample size. The current study had a wide age range, 18-60, whereas Bull and colleagues recruited only 50 participants aged 17-32 and were mainly from a university setting. As discussed in the review, risk-taking behaviours can alter with development and age (Wang et al., 2024) contributing to a potential factor in the varying results.

Nevertheless, based on the review studies by Steingroever et al. (2013) and Barnhart & Buelow, (2022), healthy participants tend to make higher selections from the disadvantageous decks, according to both the LTC scoring and frequency-based scoring, which was not adopted in the current study. As discussed in both reviews, participants focus on avoiding immediate losses whereas less focus is given to learning the long-term consequences of the decks. This serves as a potential explanation for the presence of more risk-takers in the current study. The focus of the participants was directed on immediate gains as opposed to learning to distinguish between the advantageous and disadvantageous decks. Hence, these results are in support of the review studies by Steingroever et al. (2013) and Barnhart & Buelow, (2022) but not to the study by Bull et al. (2015).

5.1.3 Executive Function

EF is an umbrella term, encompassing multiple cognitive processes, such as inhibitory control, attention, and WM. EF can further be categorised into three domains, namely inhibitory control, WM, and cognitive flexibility. The literature concerning inhibitory control and WM allude to the understanding that these two processes are psychologically distinct yet are functionally associated with each other. Particularly, it is argued that WM facilitates inhibition, such that improvement on inhibition tasks is demonstrated by higher WM. The understanding is that WM requires holding and manipulating information in the mind which is a function linked to inhibitory control (Duell et al., 2018). Contextually, when participants performed the CW aspect of the Stroop task, they were required to hold in mind the instruction of reading out the colour ink instead of the colour word. Similarly, when engaged in the DSB and DSS, they were to hold the number sequence in mind and manipulate the information by placing it in the correct order before being able to produce a response. Hence, both tasks shared similar cognitive processes. Duell and colleagues carried out a study to examine the association between WM and inhibition on the Stroop task on a sample of adolescence and early adults. Their results indicated that WM was associated with inhibitory control across development, such that the higher WM abilities, the higher the ability to inhibit interferences. This association is supported by correlation results (Table 3) from the current

study, such that both the DSB and DSS were significantly correlated to the Stroop W, C, and CW tasks. Hence, WM and inhibition are associated, but this association does not apply to the Stroop Interference Score.

Furthermore, it is argued that EF facilitates academic performance, whereby higher EF is related to higher academic performance (Freitas et al., 2022). De Waal et al. (2023) undertook a study with an aim of determining the degree to which EF influenced academic achievement. It was further aimed at identifying if SES influenced the role of EF on academic achievement. The sample were 12-year-old, grade 7, students from the North-West Province in SA. Their results revealed that EF was significantly correlated with academic achievement, specifically in languages, mathematics, and grade average. With reference to the role of SES, their result further indicated that participants from low SES backgrounds performed below average on EF tasks and in overall academic performance. In the current study, the DSF and DSB results indicated that participants had a good short-term and working memory, respectively, however they presented with difficulty in inhibiting interferences. Additionally, participants were objectively and subjectively measured as falling part of an average to high SES bracket. Based on their schooling levels, the majority of them had 12, and more, years of education, indicating excellent academic performance. Therefore, the current study does conform to the study by De Waal and colleagues, however, definitive conclusions cannot be made as the association between academic performance, EF, and SES was not explored in the current study. Moreover, the sample from De Waal and colleagues' study was drawn from a primary school level education and thus their future level of education and academic performance cannot be determined and evaluated in relation to EF as both academic performance and EF have potential to change with development. Furthermore, it cannot be directly comparable to the participant's level of education of the current study.

Although the EF results are in conformity with studies conducted by De Waal et al. (2023) and Duell et al. (2018), it is of importance to make salient the challenges associated with measuring EF among individuals. EF is a multidimensional cognitive process, involving various processes simultaneously operating. Hence, the challenge of EF begins with operationalising the construct. Although EF is categorised into inhibitory control, WM, and cognitive flexibility, there are additional cognitive processes, such as attention, concentration, and problem solving to name a few, that can potentially influence EF. In defining EF, most researchers associate it with overall cognitive function, human performance, goal directed behaviour as well as in relation to hot and cold factors. However, according to a systematic

review most studies fail to discuss the self-relevant goals aspect of EF (Mousavi et al., 2022). This indicates that the EF provides individuals with the ability to regulate and achieve their goals through the process of inhibiting interferences, remembering previous information, and decision making together with personal values, beliefs, and desires which codevelop with EF and varies among individuals. This, as further argued by Mousavi and colleagues hinders with the transference of EF performance under standardised conditions and in real-life situations, as personal values, beliefs, and desires are often not accounted for in the former situational conditions.

On the contrary, non-cognitive factors, such as physical activity and gross motor skills can further influence the development of EF (Cook et al., 2019). In exploring this association Cook and colleagues measured physical activity, gross motor skills, and EF abilities in a sample of preschool children, aged 3-6 years from both urban and rural settings in SA. Their results revealed that gross motor skills were more associated with EF than physical activity. This is as physical activity was not significantly associated with the inhibition or cognitive shifting aspect of EF, however, it was negatively associated with WM. With reference to gross motor skills a slightly opposite association was found, such that gross motor skills were significantly and positively associated with inhibition and WM, but not cognitive shifting. These results make it clear that EF is multidimensional, and its development can thus be influenced by several factors.

Since EF comprises an interplay of several processes, it cannot be measured with a single measure. There are several different assessments designed for inhibitory control, aspects of WM such as short- and long-term memory, and cognitive flexibility. This results in different studies measuring EF through varying assessments, each capturing a different aspect of EF. In addition to the different measures, some measures are performance-based whereas others are self-report. The former is argued to be more accurate as it measures the cognitive ability under study, whereas the latter can be limiting due to self-report bias (Nyongesa et al., 2019). In addition, a crucial aspect of performative based assessments is reaction time. This is often not captured yet it provides the participant's general cognitive ability in relation to their performance on EF tasks. Furthermore, the majority of EF measures were developed in high-income Western countries resulting in cultural biases (Obradović & Willoughby, 2019). This implies that individuals from low-income countries may not be familiar with the tasks, languages, and concepts of the assessments, resulting in their performance being low due to misunderstanding and not related to EF abilities. Taken together, these methodological

differences contribute to the different results. As such, these differences in methodologies pose a challenge in summarising conclusive results from individual studies (Schirmbeck et al., 2020).

5.1.4 SES and Executive Function

In exploring the aim of investigating how SES is associated with EF, particularly inhibitory control and WM, a significant result was not obtained. Several studies have demonstrated that higher SES is associated with improved performance on EF assessments (Mousavi et al., 2022). However, based on the regression model, in the results section, neither objective nor subjective SES measures were significantly associated with inhibitory control and WM, as measured by the DSB and Stroop Interference score respectively. It is crucial to note that the current study did not aim to measure SES as a predictor of one's EF abilities, nor did it aim to define one's EF abilities in relation to their SES. Furthermore, in alignment with the study's non-experimental design, casual claims cannot be made regarding SES and EF abilities.

As discussed above, conceptualising and operationalising SES and EF as independent constructs pose several challenges. Taking these constructs together, the different measures adopted in studies to measure SES and EF vary, producing different results. In addition, development does not occur in isolation. The development of EF abilities continues from childhood to early adulthood, hence, in addition to SES, a number of neurological, environmental, cultural, and contextual factors can influence this development (Sakshi, 2021). It is argued that EF abilities develop in response to personality traits, regulation skills during social interactions, rule-following and emotion control in educational settings, as well as societal rules and stereotypes (Monterio, 2021). Furthermore, studies have demonstrated that bilingual individuals have improved EF abilities in comparison to monolingual individuals (Schirmbeck et al., 2020).

The consensus is that individuals who speak more than one language have a higher EF network, particularly in relation to inhibition (Cockcroft et al., 2019). This is as bilinguals, extending to multilinguals, are to inhibit languages based on the language they are conversing with. Hence, there is a strong presence of suppression of one language over the other. In exploring the association between multilingualism and WM, Cockcroft et al. (2019) conducted a study on South African young adults who spoke two African languages in addition to speaking English. After the completion of a comprehensive WM task, measuring different aspects of WM, the overall results showed that these multilingual individuals

possessed a range of WM advantages, and in comparison to monolingual individuals, they were not present with any WM disadvantages, irrespective of SES. Additionally, as stated by the authors, multilingualism has the potential to alleviate the negative influence that SES may have on cognition. In reference to the current study, the Language Experience and Proficiency Questionnaire, Shorten Version (LEAP-Q-SV-) questionnaire (Appendix C), although not included in the study for analysis, revealed that the majority of the participants spoke more than one language. This bilingual trait could have played an influential role in the positive cognitive abilities presented by the participants, accounting for the absence of the SES-EF association. However, claims cannot be made as the effects of language on EF, was not the aim of the study.

Similarly, SES is not a rigid situation but rather alters with the broader social context, such as the cultural and political structures of one's environment (Freitas et al., 2022). For example, the economy of one's country, the activities available at school, the type of books and toys sold in a community, living conditions, as well as the security of the community all have potential to influence the development of neurocognitive abilities, such as EF processes. In exploring the socio-environmental factors on the development of EF abilities, Freitas and colleagues found that children residing in a rural region exhibited a higher performance in WM measures and were faster, with minimal errors, in the inhibitory control tasks. These were in comparison to children residing in an industrial region. As discussed by the authors, these differences are attributed to different living conditions between the rural and industrial regions. Facilities, such as homes, schools, farms, and relatives are closely located, allowing for an extensive collaborative environment that is heavily dependent on social interactions. Moreover, these children spend most of their time outdoors playing informal games, which may aid in their EF abilities. On the other hand, children in industrial areas spend a lot of time travelling to schools, homes, and other recreational facilities, thereby they spend more time indoors, limiting social interactions with community members. Additionally, these results may be attributed, as discussed in the literature above, to the interdependence and independent nature of individuals from different social classes. The interdependent nature is more often present in individuals from the lower social class, who further present with increased social cognition in comparison to individuals from a higher social class (Fendinger et al., 2023).

In determining the environmental predictors of EF, Milosavljevic et al. (2023) carried out a study within two low-to-middle-income contexts to examine the EF abilities among

preschool children, with a sample consisting of both children and their caregivers. Participants were recruited from four low-income communities in Cape Town, SA. The characteristics of these communities included diverse ethnic and religious groups, different levels of SES, and family structure were a combination of nuclear families, single-parents, and child-headed families. Moreover, two communities comprised mainly of informal housing, and the other two of both formal and informal housing. Hence, these communities, specifically with informal housing, were overpopulated, with high unemployment, food insecurity, and crime. The second context of the study was from the Gambia, located in the rural West-Kiang region of SA. The community from which these participants were drawn consisted mainly of farming areas with multigenerational families, whereby children tend to uphold adult responsibilities. In reference to SES, most were below the poverty line.

Despite the diverse conditions of the two contexts in which the study was conducted in, Milosavljevic and colleagues (2023) did not find significant relationships between SES, family factors, and EF. Hence, their results were in direct contrast to the notion that low SES is associated with lower cognitive abilities (Fendinger et al., 2023). In fact, the authors found that children exhibited the same level of performance on EF tasks as children of the same age in higher-income countries. This is as the tasks used in the study were developed and standardised in Australia, yet the children performed synonymously as did children in Australia. Moreover, the varying family structure was also not associated with EF skills. These results, despite the differences in sample population, size, and tasks administered, are in conformity with the current study, as SES was not a predictor of EF.

5.1.5 SES and Risk-Taking Behaviour

The effects of SES on decision-making provides an understanding of how both general decisions and risk-taking behaviour varies among individuals. The consensus is that objective SES is associated with risk aversion, such that individuals who score low on objective SES measures tend to be more risk aversive (Weissberger et al., 2022). In addition, in exploring this association with subjective SES measures, the results of Weissberger et al. (2022) study indicated that individuals who have a low subjective financial standing tend to be more risk aversive. In the current study, objectively, based on the LSM category, participants were of a higher SES bracket. Similarly, based on the subjective measures, they were in the average SES bracket and the least number of individuals placed themselves in the lower SES bracket. Their IGT performance revealed a higher level of risk-taking behaviour. Hence, the results

are aligned with the SES and risk-taking behaviour association as explained by Weissberger and colleagues.

In examining the degree to which decision-making differs in relation to SES, Delgado et al. (2022) administered the Children's Gambling task to children aged between 5-7 years who were categorised into groups based on their SES. Their main finding was that children in the middle/high SES bracket displayed a better performance in comparison to children in the low SES bracket for the whole gambling task. In addition, although children from the lower SES bracket showed an improvement in their performance across the trials, their decision-making process was not future oriented whereas their peers in the middle/higher SES bracket made increased selections from the advantageous decks. In comparing these results to the current study, the samples were objectively and subjectively measured as belonging to a high and average SES bracket, respectively, yet they displayed risk-taking tendencies in contrast to the children from the middle/high SES bracket. Additionally, although they showed improvement in their performance across the trials, as with the children from the lower SES bracket, it can be argued that the participants were not future oriented. Although these results may vary as a result of the sample's age differences within the studies, these results show that discrepancies among SES and risk-taking behaviours are present. Moreover, it suggests that the association between decision-making processes and consequently risk-taking behaviours and SES has the potential to be effective from an early age.

5.1.6 Cognitive and Affective Factors

In addition to being risk averse or risk-taker, the IGT can potentially measure decision-making under ambiguity and under risk. As discussed in the review above, decision-making under ambiguity occurs when outcome options are unknown, whereas under risk options are known and therefore evaluated to make informed choices (Colautti et al., 2022; Ouerchefani et al., 2019). This pattern of decision-making was made present in the current study as per the ANOVA results (Figure 4). Within block 1 and 2, participants made decisions that were negative, however, their performance increased by block 5, indicating that they were engaging in decision-making that yielded more positive outcomes.

In exploring decision making under ambiguity and risk, Sun et al. (2020) conducted a study on patients with mild cognitive impairment, Alzheimer's disease, as well as on healthy controls. Based on participant's performance on the IGT, Sun and colleagues found that the mild cognitive impairment and Alzheimer's diseases patients did not show any significant

changes during the entire task. On the other hand, the healthy control participants changed their performance during the task with the tendency towards more advantageous deck selections. This, as discussed by the authors, implies that healthy individuals modified their strategy during the course of the IGT task based on the feedback they received. This ability was absent in mild cognitive impairment and Alzheimer's disease patients. Therefore, as illustrated by Sun's study and the current study, healthy participants utilise the first two blocks to explore their choices and outcome and over the last three blocks, they developed a strategy to choose more advantageous options, supporting the exhibition of initial decision-making under ambiguity followed by under risk. Furthermore, the study by Sun and colleagues found that EF and memory is associated with decision-making under risk as these cognitive abilities are required to adopt the strategy for positive decision-making based on the initial feedback. This then leads to the hot and cold cognitive factors of EF that are potentially associated with decision-making.

Decisions made under ambiguity and under risk include the involvement of EF processes, particularly the hot and cold factors of EF. As described above, cold factors are functions that are guided by cognition and hot factors are guided by emotions and motivation (Colautti et al., 2022; Demaree et al., 2010). Particularly, the hot components of EF are often exhibited when immediate decisions are made, however, the cold components are exhibited within stable conditions as it allows for the evaluation of risks and benefits (Zinchenko & Enikolopova, 2017). As such, the presence of hot and cold factors in decision-making can be observed through one's performance on the IGT, with the consensus that when the IGT is divided into the five blocks, hot components are employed within the first 2 blocks, followed by the cold components in the last three blocks. Hence, the hot and cold components are decision-making made under ambiguity and risk respectively. The change in IGT performance (Figure 4) together with the notable change in decision-making (under ambiguity and risk) alludes to the presence of cold EFs, however the definite presence of the cold components could not be made, as the IGT performance were not associated inhibition and WM (Appendix I).

Nevertheless, a study was carried out to determine the predictive nature of cognitive intelligence and emotional intelligence of IGT performance (Demaree et al., 2010). Based on the results, cognitive and emotional intelligence scores, the authors found that individuals with higher intelligence scores performed better on the IGT in comparison to individuals with lower intelligence scores. However, the emotional intelligence scores were not a significant

predictor of IGT performance. As such, IGT is mainly a cognitive task. This was further seen in the study described above by Sun et al. (2020), whereby patients with mild cognitive impairment and Alzheimer's disease performed poorly in the IGT as they failed to improve their performance in the last three blocks. Since the last three blocks are indicative of cold EF components, these results could imply that IGT does measure cognitive abilities in addition to risk-taking behaviours and decision-making processes. This further highlights the association between these constructs.

On the other hand, there are studies who reject the cognitive aspects of the IGT in favour of the hot components. The study by Portugal et al. (2018), explored the associations between behavioural performance, self-reported impulsivity, and decision-making processes in healthy participants. The authors found no significant association between Stroop/Stop performance and IGT performance. Similarly, in exploring the performance of IGT in patients with dorsolateral lesions, Zinchenko & Enikolopova, (2017) argue that there are a limited number of studies that find significant results between inhibition and IGT. These results were found in the current study as IGT scores were not significantly associated with the Stroop Interference Score (Appendix I). However, in contrast to the above, Portugal and colleagues argue that IGT is an affection/hot measure whereas inhibition measures such as the Stroop are cognitive/cold measures. Likewise, Zinchenko & Enikolopova further found that in comparison to healthy participants, only patients with right frontal lobe damage showed an interaction between emotional intelligence and IGT performance. Hence, among this clinical population specifically, and not within a healthy population, impairment in IGT performance reflects the hot components.

According to a scoping review, several studies have found an association between IGT performance, WM, and inhibition (Colautti et al., 2022) while some have not found such an association (Portugal et al., 2018; Zinchenko & Enikolopova, 2017). However, the studies by Portugal and Zinchenko did not divide the IGT trials into blocks, and only measured cognition across the 100 trials as a whole. The study does not support the association between inhibition and WM (Appendix I). However, the ANOVA and WM results, suggest that participants were of an average and above average WM, hence they were able to remember the outcomes of the decks which is seen in their IGT performance (Figure 4) which progressed to healthy choices. It is argued that healthy participants who are risk-takers, based on their IGT performance, have difficulty inhibiting their responses to risky choices (Damasio et al.,1996). This is supported in the current study as participants had a low ability

to inhibit interferences (Stroop Interference Score) and were classified as risk takers. Taken together, these results support the underlying assumptions of the SMH, as developed by Damasio and colleagues, in that WM and inhibition play an active role in effective decision-making.

5.2 Strengths, Limitations, and Future Directions

The strength of the current research was the sample size and composition. The sample comprised of 96 participants which is a good sample size for the current research. Moreover, it comprised of individuals from various ethnic groups; majority of whom self-identified as Indian and Black. Individuals from these ethnic groups are often under researched, hence their participation contributes to the growing literature from non-WEIRD settings. However, there were still limitations in the sample size in that potential differences in results in various socio-demographic groups could not be analysed, due to the small number of participants in each demographic group. Future studies could include a much larger sample that would allow for the division of the sample into different groups according to various socio-demographic data in order to understand the complex relationship between these factors and the key variables in the study.

Another strength present in the study was the use of both objective and subjective SES measures. This allowed for a more comprehensive understanding of the SES among the participants. It further showed variability in responses, highlighting potential methodological implications in studies. However, the study did not group participants based on their SES bracket. Thus, EF performance and risk-taking behaviours could not be compared based on a SES level, such as low SES, average SES, and high SES. Future studies should include this categorisation to obtain a greater insight into the association between SES, EF, and risk-taking behaviours.

The major limitation of the current study was that reaction time was not recorded for the Stroop Colour and Word Test. Moreover, although the error rates were recorded, it was not used in the scoring. As such, the Stroop Effect could not be calculated. This further implies that a more accurate measure of inhibition was not obtained. This limitation could have been avoided through the use of administering a digital version of the Stroop Colour Word Test. The digital version would capture the participant's reaction time and errors with absolute accuracy. In general, and as seen with the digital version of the IGT, digital assessments are cost-effective, easy to administer, standardised protocols and assessment procedures, and

further accelerates data processing and analysis (Obradović & Willoughby, 2019). In contrast, the traditional pen-paper administration method is cost intensive and allows for human error in administration and scoring.

The LSM measure was a limitation. This measure was the 2011 version; hence it does not capture the current household assets and amenities but rather outdated ones. For instance, it asked if the household had a TV set, a DVD player, M-Net Subscription, and radios. With the advancement of technology, these could be replaced with smart TVs and devices, WIFI/Fiber in the home, inverter and generators, power banks, as well as subscriptions for streaming platforms such as Netflix.

Another limitation of the study is concerned with the IGT. Although the administration and completion of the IGT using digital and offline administration proved to be effective, the monetary currency was in dollars which is not contextually appropriate as the currency for SA is rands. Although not definitive, performance may or may not have improved based on the use of Rands as opposed to Dollars. In the case of rands, participants would have had a better understanding of the value of the gains and losses that they encountered. Nevertheless, the ease of administration of the IGT as a digital and offline task supports the notion that digital assessment tools are feasible for low-to-middle income contexts, like SA.

Another limitation of the study was the age range included. Although the study was focusing on an adult population in general, there was a special focus on young adults in SA. As the study fell part of a larger study, the age range was expanded to recruit a larger group of participants from 18-60 years. To increase the sample size and power of the study, the sample included participants within this range, however, the average age of the sample still consisted of young adults, which is aligned to the wider objectives of the study. However, future studies arising from this work may want to include participants from 18-30 years, to refine the focus of the study to include only a young adult population.

In assessing EF, the study only explored inhibitory control and WM. The third aspect of EF, cognitive flexibility was not assessed for several reasons. First, EF is a broad construct, encompassing various cognitive processes, making it impractical to measure all aspects of EF within a single study. Additionally, the study was part of a larger project in which cognitive flexibility was not measured, hence including cognitive flexibility would result in a misalignment within the study's scope. To ensure feasibility and avoid overburdening participants, the assessment duration was limited to one hour. Including cognitive flexibility

would have extended the assessment period beyond this limit. Finally, the research was primarily concerned with risk-taking behaviours. Among the three constructs of EF-inhibitory control, WM, and cognitive flexibility-prior research indicates that inhibitory control and WM are more closely associated with the decision-making processes and risk-taking behaviours. Therefore, these two constructs were prioritised for investigation in this study.

In relation to the hot and cold EF, the current study did not include a measure of hot functions. This is not a limitation per say as it was not the main aim of the study, however, future research should include both hot and cold measures to assess its association with risk-taking behaviours.

Therefore, the current research can be replicated with the use of digital measures to capture a more accurate performance rate for EF, an updated version of the LSM, as well as a contextually relevant IGT. Moreover, future studies can include additional EF measures, or a battery of EF assessments, as the current study only included two. This will allow for more precision and accurate representation of one's EF abilities (Obradović & Willoughby, 2019).

Conclusion

The current study aimed to investigate how wider social-cultural and economic factors, such as SES, and higher-order cognitive abilities, specifically, EF, influence risk-taking behaviours in a sample of South African adults. The results of this study suggest that these factors are not associated since SES was not a significant predictor of EF, particularly, inhibitory control and WM, or risk-taking behaviours. There were variances present in measuring SES using objective and subjective measures, as the former placed participants in a higher SES bracket, whereas participants subjectively rated their financial situations as average. The sample had good WM, but a weak ability to inhibit interferences. The sample was further risk-takers, however, their performance on the IGT showed the presence of decision-making under ambiguity and risk. However, risk-taking behaviour was not associated with inhibition and WM, indicating that the cold component of EF was not measured on the IGT. Further research with a larger sample size is required to determine a more concrete association between the three constructs. However, the study contributes to the methodological challenges in assessing these constructs as well as the shared association of these constructs.

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Appendix A: Consent Form



Psychology
School of Human & Community Development
University of the Witwatersrand
Private Bag 3 Wits, 2050
Tel: 0117174503 Fax: 0117174559

Consent Form

Title of project: Exploring the relationship between demographic factors and the performance in cognitive tests: exploring the mediating power of speed of processing.

Title of sub-project: The role of executive function and socioeconomic status on risk-taking behaviours in the low-to-middle income context of South Africa.

Name of researcher: Mayuri Lalla
Supervisor: Dr Sahba Besharati

NB: Please note that as a participant, you can withdraw from this study/participation at any point without any prejudice/penalties.

I, ……., agree to participate in this research project.

I agree to the following:

(Please circle the relevant options below)

The research study was explained to me. I understand what this study is about.	YES	NO
I understand that I can volunteer to take part in the study.	YES	NO

I agree that my participation will remain anonymous (my name or other identifying data will not be used by the researcher in their research report)	YES	NO
I agree that other researchers may use the information I provide in my activity (depending on their own ethics clearance being obtained) but my name and any personal information will not be used or passed on.	YES	NO
I agree that any of the information that I provide can be stored by the supervisor and used as secondary data.	YES	NO

…… (signature)

…… (name of participant)

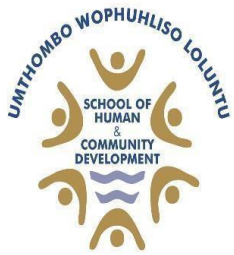
…… (date)

……  …… (signature)

……Mayuri Lalla……(name of researcher/person seeking consent)

……08 Jun. 23…… (date)

Appendix B: Participation Information Sheet



Psychology
School of Human & Community
Development
University of the Witwatersrand
Private Bag 3 Wits, 2050
Tel: 0117174503 Fax: 0117174559

Participant Information Sheet

Good day

My name is Mayuri Lalla. I am a master's student (1870401) in Psychology, by Coursework and Research Report at the University of the Witwatersrand, Johannesburg. My supervisor is Dr Sahba Besharati. I am conducting research as part of a larger project investigating the relationship between cognitive variables (e.g., verbal fluency, processing speed, working memory and executive function), risk taking and demographic characteristics (age, years of education, socio-economic status, and language profile). My study title is *"The role of executive function and socioeconomic status on risk-taking behaviours in the low-to-middle income context of South Africa"*.

I would like to invite you to take part in my study which will require you to answer questions, solve some problems, and complete pen and pencil activities. Your participation will be confidential. Only the members of the research team will have access to the anonymous results (without your name). When I share the results of the study, I will not include your name or any information that could identify you and the results will be reported in groups and not individually. With your permission, other researchers may use the data collected from this study in future studies, but your names and any personal information will not be used or passed on.

The data will be stored in a protected device and the results will be available on the Internet (World Wide Web) via the University's library website and potentially published in scientific journals and presented at conferences. If you wish to have access to the results, please contact me or my supervisor using the details below.

If you decide to take part in the research study, it should be because you want to volunteer, and you can withdraw from participation at any point without any penalties. You do not have to answer any questions if you do not want to. You will not get any direct benefits if you choose to join the research study. You will not lose any services, benefits, or rights you would normally have if you decided not to join. Taking part in the research study will not cost you anything. You will not be paid for being in this research study. However, we will compensate your transport costs (R. 90,00).

If you have any questions during or afterwards about this research study, feel free to contact me or my supervisor on the details listed below: 1870401@students.wits.ac.za or sahba.besharati@wits.ac.za. If you have any concerns or complaints about the ethical procedures of this research study, you are welcome to contact the University Human Research Ethics Committee (Non-Medical), telephone +27(0) 11 717 1408, email hrecnon-medical@wits.ac.za

Yours sincerely,
Mayuri Lalla (Researcher)
076 184 2062

Research supervisor:
Dr Sahba Besharati
+27(0)11 717 4529

Appendix C: Demographic Questionnaire

Demographic Questionnaire

Name: _____

Surname: _____

Age: _____

Date of Birth: D D M M Y Y Y Y

Gender: _____

Ethnicity: _____

Home Language: _____

Highest Level of Education: _____

Have you ever failed a grade in school? If so, which one? _____

Have you ever required intervention from a language specialist? _____

Have you ever been diagnosed with a neurological, metabolic or psychiatric illness?

_____

Educational and occupational status of your parents or primary caregivers:

Mother: Level of Education		**Father: Level of Education**	
No schooling		No schooling	
Less than primary school completed		Less than primary school completed	
Primary school completed		Primary school completed	
Secondary school not completed		Secondary school not completed	
Secondary school completed		Secondary school completed	
Tertiary education completed		Tertiary education completed	
Other		Other	
Current occupation:		Current occupation:	

Subjective experience of financial resources (fiscal appraisal)

Income comparison

1. How would this household classify its financial situation these days?
   5-point scale ("Much above average income" to "Much below average income").

2. How would you classify your household in terms of income, compared with other households in your community?
   5-point scale ("Very comfortable" to "Extremely poor")

Subjective standing

Please imagine a ten-step ladder where the poorest people in South Africa stand on the bottom (the first step) and the richest people in South Africa stand on the highest step (the tenth step). On which step are you today?

10-point scale

Living Standards Measure:

Please answer the below questions according to your current circumstances

Question	Answer	
1. I have the following in my household		
TV Set	True	False
Swimming pool	True	False
DVD player	True	False
M-Net/DStv subscription	True	False
Air conditioner	True	False
Computer / Laptop	True	False
Vacuum cleaner/floor polisher	True	False
Dishwashing machine	True	False
Washing machine	True	False
Tumble dryer	True	False

Home telephone (excluding a cell)	True	False
Deep freezer	True	False
Fridge/freezer (combination)	True	False
Electric stove	True	False
Microwave oven	True	False
Built-in kitchen sink	True	False
Home security service	True	False
3 or more cell phones in household	True	False
2 cell phones in household	True	False
Home theatre system	True	False
2. I have the following amenities in my home or on the plot:		
Tap water in house/on plot	True	False
Hot running water from a geyser	True	False
Flush toilet in/outside house	True	False
3. There is a motor vehicle in our household	True	False
4. I am a city dweller	True	False
5. I live in a house, cluster or town house	True	False
6. I live in a rural area outside Gauteng	True	False
7. There are no radios, or only one radio (excluding car radios) in my household	True	False
8. There is no domestic workers or household helpers in household (both live-in & part time)	True	False

Shortened Version of Language Experience and Proficiency Questionnaire (LEAP-Q-SV)

1. What languages do you know?

Language A: _____

Language B: _____

Language C: _____

Language A:

This is my _____ (First, second, third) language. All questions below refer to your knowledge of language A.

(1) Age when you...

Began acquiring this language: _____

Became fluent in this language: _____

Began reading in this language: _____

Became fluent reading in this language: _____

(2) Please circle your level of proficiency in speaking, understanding, and reading in this language:

0	1	2	3	4	5	6	7	8	9	10
None	Very Slightly	Low	Fair	Slightly	Adequate		Good	Very Good	Excellent	Perfect
	Low			less than adequate		more than adequate				

Understanding spoken language

0	1	2	3	4	5	6	7	8	9	10
None	Very Slightly	Low	Fair	Slightly	Adequate		Good	Very Good	Excellent	Perfect
	Low			less than adequate		more than adequate				

Reading

0	1	2	3	4	5	6	7	8	9	10
None	Very Low	Fair	Slightly	Adequate	Slightly	Good	Very	Excellent		
	Perfect Low		less than		more than					
Good adequate					adequate					

Language B:

This is my _____ (First, second, third) language. All questions below refer to your knowledge of language B.

(1) Age when you...

Began acquiring this language: _____

Became fluent in this language: _____

Began reading in this language: _____

Became fluent reading in this language: _____

(2) Please circle your level of proficiency in speaking, understanding, and reading in this language:

Speaking

0	1	2	3	4	5	6	7	8	9	10
None	Very Slightly	Low	Fair	Slightly	Adequate		Good	Very Good	Excellent	Perfect
	Low			less than adequate		more than adequate				

Understanding spoken language

0	1	2	3	4	5	6	7	8	9	10
None	Very Slightly	Low	Fair	Slightly	Adequate		Good	Very Good	Excellent	Perfect
	Low			less than adequate		more than adequate				

Reading

0	1	2	3	4	5	6	7	8	9	10
None	Very Low	Low	Fair	Slightly less than adequate	Adequate	Slightly more than adequate	Good	Very Good	Excellent	Perfect

Language C:

This is my _____ (First, second, third) language. All questions below refer to your knowledge of language C.

(1) Age when you...

Began acquiring this language: _____

Became fluent in this language: _____

Began reading in this language: _____

Became fluent reading in this language: _____

(2) Please circle your level of proficiency in speaking, understanding, and reading in this language:

Speaking

0	1	2	3	4	5	6	7	8	9	10
None	Very Slightly	Low	Fair	Slightly	Adequate		Good	Very Good	Excellent	Perfect
	Low			less than adequate		more than adequate				

Understanding spoken language

0	1	2	3	4	5	6	7	8	9	10
None	Very Slightly	Low	Fair	Slightly	Adequate		Good	Very Good	Excellent	Perfect
	Low			less than adequate		more than adequate				

Reading

0	1	2	3	4	5	6	7	8	9	10
None	Very Low	Low	Fair	Slightly less than adequate	Adequate	Slightly more than adequate	Good	Very Good	Excellent	Perfect

Appendix D: Ethics Training Certificate



TRREE

Zertifikat

Certificado

Certificat

Certificate

Promouvoir les plus hauts standards éthiques dans la protection des participants à la recherche biomédicale
Promoting the highest ethical standards in the protection of biomedical research participants

Certificat de formation - Training Certificate

Ce document atteste que - this document certifies that

Clinical Trials Centre
The University of Hong Kong

Mayuri Lalla

a complété avec succès - has successfully completed

Introduction to Research Ethics

du programme de formation TRREE en évaluation éthique de la recherche
of the TRREE training programme in research ethics evaluation

Release Date: 2023/04/17

Professeur Dominique Sprumont
Coordinateur TRREE Coordinator

APPROVED BY SIWF FMH ISFM
de formation continue (2 crédits)
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[REV: 20220217]

Appendix E: Ethics Clearance Certificate

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

SCHOOL OF HUMAN AND COMMUNITY DEVELOPMENT ETHICS COMMITTEE

CONSTITUTED UNDER THE UNIVERSITY HUMAN RESEARCH ETHICS COMMITTEE (NON-MEDICAL)

CLEARANCE CERTIFICATE	**PROTOCOL NUMBER: MAPSYC/23/05**
PROJECT TITLE:	The role of executive function and socioeconomic status on risk-taking behaviours in the low-to-middle income context of South Africa.
INVESTIGATOR	Lalla Mayuri (1870401)
SCHOOL/DEPARTMENT OF INVESTIGATOR	SHCD/Psychology
DATE CONSIDERED	19 June 2023
DECISION OF THE COMMITTEE	Approved unconditionally
RISK LEVEL	Low Risk
EXPIRY DATE	31 December 2025

ISSUE DATE OF CERTIFICATE: 05 July 2023

Aline Ferreira Correia

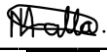
CHAIRPERSON: (Dr Aline Ferreira Correia)

cc: Dr Sahba Besharati (Supervisor)

DECLARATION OF INVESTIGATOR

To be completed in duplicate and **ONE COPY** returned to the Chairperson of the School/Department ethicscommittee.

I/we fully understand the conditions under which I am/we are authorized to carry out the abovementioned researchand I/we guarantee to ensure compliance with these conditions. Should any departure be contemplated from the research procedure as approved, I/we undertake to submit an amendment of the protocol to the Committee.



Signature

Date: 01/08/2023

PLEASE QUOTE THE PROTOCOL NUMBER ON ALL ENQUIRIES

Appendix F: Permission Clearance (Head of Department)

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG | PSYCHOLOGY

22 August 2023

Lalla Mayuri

TO WHOM IT MAY CONCERN

"The role of executive function and socioeconomic status on risk-taking behaviours in the low-to-middle income context of South Africa"

This letter serves to confirm that the above project has received permission to be conducted on University premises, and/or involving staff and/or students of the University as research participants. In undertaking this research, you agree to abide by all University regulations for conducting research on campus and to respect participants' rights to withdraw from participation at any time.

As Head of the Department of Psychology, I grant permission for you to approach staff in order to invite Psychology students to participate in your research.

Ethical clearance has been obtained. (Protocol number: MAPSYC/23/05)

Yours sincerely,



Prof Carol Long, Head of Department, Psychology

☎ +2711 717 4510 ✉ carol.long@wits.ac.za

Umthombo Building – 2nd Floor, Room U211, Braamfontein East Campus, Private Bag 3, WITS 2050
T +27 11 717 4503/53 | **E** psych.SHCD@wits.ac.za | www.wits.ac.za/shcd/psychology/

Appendix G: Permission Clearance (Registrar)

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

OFFICE OF THE DEPUTY REGISTRAR

23 August 2023

Mayuri Lalla
Student Number (1870401)
Master of Arts by Coursework and Research ReportSchool of Human and Community Development

TO WHOM IT MAY CONCERN

"The role of executive function and socioeconomic status on risk-taking behaviours in the low-to-middle income context of South Africa."

This letter serves to confirm that the above project has received permission to be conducted on University premises, and/or involving staff and/or students of the Universityas research participants. In undertaking this research, you agree to abide by all Universityregulations for conducting research on campus and to respect participants' rights to withdraw from participation at any time.

If you are conducting research on certain student cohorts, year groups or courses within specific Schools and within the teaching term, permission must be sought from Heads of School or individual academics.

Ethical clearance has been obtained. (Protocol number:

MAPSYC/23/05)Research Expiration: (31 December 2025)



Nicoleen Potgieter

University Deputy Registrar

Private Bag 3, WITS, 2050, South Africa | **T** +27 11 717 1204/8 | **E** nicoleen.potgieter@wits.ac.za | www.wits.ac.za
IYUNIVESITHI YASEWITWATERSRAND | YUNIVESITHI YA WITWATERSRAND

Appendix H: Demographic Data

Table 6: Frequencies of Demographic Data

		N	*%*
Gender	Female	64	66.7
	Male	32	33.3
Self-Identified Ethnicity	African	75	78.1
	Indian	18	18.8
	White	2	2.1
	Coloured	1	1.0
Home Language	IsiZulu	52	54.2
	English	21	21.9
	Sepedi	21	21.9
	Other	2	2.1
YoE	Less than 12 Years of Education	15	15.6
	12 Years of Education	46	47.9
	More than 12 Years of Education	35	36.5
Grade Failed	Yes	33	34.4
	No	63	65.6
Frequency of Grades Failed	0	63	65.6
	1	24	25
	2	8	8.3
Household Financial Situation	Much Above the Average Income	3	3.1
	Above the Average Income	16	16.7
	Average Income	56	58.3
	Below the Average Income	10	10.4
	Much Below the Average Income	11	11.5
Income Comparison Community	Very Comfortable	4	4.2
	Above Comfortable	10	10.4
	Comfortable	69	71.9
	Below Comfortable	11	11.5
	Extremely Poor	2	2.1
Subjective Financial Rating	1	8	8.3
	2	-	-
	3	9	9.4
	4	17	17.7
	5	36	37.5
	6	20	20.8
	7	2	2.1
	8	2	2.1
	9	-	-
	10	1	1
Mother's Years of Education	No Schooling	6	6.3
	Less than 7 Years of Education	7	7.3
	7 Years of Education	7	7.3
	Less than 12 Years of Education	19	19.8
	12 Years of Education	34	35.4
	More than 12 Years of Education	20	22.8

	Other	2	2.1
Father's Years of Education	No Schooling	6	6.3
	Less than 7 Years of Education	6	6.3
	7 Years of Education	12	12.5
	Less than 12 Years of Education	12	12.5
	12 Years of Education	31	32.3
	More than 12 Years of Education	18	18.8
	Other	5	5.2
LSM	5	1	1
	6	11	11.5
	7	12	12.5
	8	11	11.5
	9	27	28.1
	10	34	35.4

YoE- Years of Education

Appendix I: Pearson's Correlation between IGT and EF

Table 7: Pearson's Correlation between IGT and EF

		IGT Net Score	IGT Block 1	IGT Block 2	IGT Block 3	IGT Block 4	IGT Block 5	Stroop Interference Score	DSF	DSB	DSS
IGT Net Score	*r*	1									
	p										
	n	96									
IGT Block 1	*r*	.517	1								
	p	*<.001*									
	n	96	96								
IGT Block 2	*r*	.742	.353	1							
	p	*<.001*	*<.001*								
	n	96	96	96							
IGT Block 3	*r*	.764	.221	.483	1						
	p	*<.001*	*.031*	*<.001*							
	n	96	96	96	96						
IGT Block 4	*r*	.780	.278	.433	.516	1					
	p	*<.001*	*.006*	*<.001*	*<.001*						
	n	96	96	96	96	96					
IGT Block 5	*r*	.812	.345	.489	.484	.521	1				
	p	*<.001*	*<.001*	*<.001*	*<.001*	*<.001*					
	n	96	96	96	96	96	96				
Stroop Interference Score	*r*	.019	-.057	-.075	.152	.095	-.079	1			
	p	.857	.581	.470	.141	.362	.444				
	n	95	95	95	95	95	95	95			
DSF	*r*	.326	.189	.128	.329	.216	.304	-.093	1		
	p	.001	.068	.217	.001	.036	.003	.374			
	n	94	94	94	94	94	94	93	94		
DSB	*r*	.135	-.045	.064	.170	.080	.159	.036	.402	1	
	p	.188	.660	.535	.098	.441	.123	.730	*<.001*		
	n	96	96	96	96	96	96	95	94	96	
DSS	*r*	.074	-.087	.013	.070	.083	.118	.099	.232	.550	1
	p	.479	.406	.898	.505	.429	.257	.343	.026	*<.001*	
	n	94	94	94	94	94	94	93	92	94	94