The impact of anxiety on cognitive functioning among a cohort of adolescents living in KwaZulu-Natal, South Africa.

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Abstract

Anxiety symptoms can affect cognitive functioning, yet little is known about this relationship in low- and middle-income countries. This study aimed to examine the prevalence of anxiety and explore whether anxiety symptoms are associated with reduced cognitive performance among a cohort of adolescents in KwaZulu-Natal, South Africa, drawing on Attentional Control Theory (ACT).

The study employed secondary analysis from a longitudinal study. Wave Three data of this study was used, which comprised 945 adolescents aged 13 to 19 years. Anxiety symptoms were assessed using the Generalised Anxiety Disorder 7 (GAD-7) scale. Cognitive functioning was assessed using six of the Kaufman Assessment Battery for Children - Second Edition (KABC-II) domains, which measured sequential processing, simultaneous processing, planning, and learning. Descriptive statistics estimated prevalence, and chi-squared analysis examined the association between anxiety severity and cognitive performance.

Data were collected in peri-urban areas of eThekwini District, KwaZulu-Natal, South Africa, through face-to-face interviews and standardised assessments conducted in participants' home language. The study employed a cross-sectional design using Wave Three data from a longitudinal cohort study.

The results indicated that 32.8% of participants presented with mild anxiety and 4.4% with severe anxiety, with no significant differences by age or gender. There were no significant associations between mild anxiety symptoms and cognitive performance across any of the subtests. Severe anxiety showed no significant associations after the Bonferroni correction was applied, although Pattern Reasoning (timed) demonstrated a trend towards enhanced performance among participants with severe anxiety symptoms.

These results suggest a relatively high prevalence of mild anxiety and an expected level of severe anxiety within this population. Contrary to theoretical predictions, anxiety symptoms were not associated with reduced cognitive functioning in this population. The minimal cognitive impact may suggest that environmental factors moderate this association, which is not fully captured by Western-derived theories. The negatively skewed cognitive performance across anxiety groups may indicate that socio-economic factors may exert a more substantial influence on cognitive functioning than anxiety symptoms. These findings highlight a need for a culturally grounded theoretical framework and community-level intervention addressing structural determinants of adolescent mental health.

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Chapter 1

1.1 Introduction

Understanding how anxiety symptoms impact cognitive functioning is a pressing question in contemporary psychology. The implications of this impact are far-reaching and extend into educational policies, clinical practice, and public health. This question becomes particularly urgent when looking at adolescents living in South Africa. This population faces unique developmental challenges within a complex socioeconomic environment. Traditional theoretical frameworks may not fully capture the nuanced ways in which anxiety and cognitive functioning interact in a high-stress, low-resource environment.

Anxiety is a universal experience characterised by feelings of worry, nervousness, and unease about potential future events. These symptoms encompass both physical and psychological manifestations that can significantly impact daily functioning (Zeidner & Matthews, 2010). Whilst some level of anxiety can be adaptive and help an individual detect and avoid danger by priming the brain for harm avoidance, these symptoms can become a problem when their intensity or persistence begins to interfere with daily functioning and well-being (Beddington et al., 2008; Robinson et al., 2013). Understanding precisely how anxiety symptoms affect cognitive functioning has become crucial for developing effective interventions and educational policies, particularly in populations where environmental stressors may amplify anxiety-cognition relationships.

Adolescence holds particular significance for anxiety-cognition research due to converging developmental factors, although anxiety symptoms affect individuals across the lifespan (Omotoso, 2007; Polanczyk et al., 2015). Adolescence is a critical developmental period characterised by an increased vulnerability to anxiety disorders (Polanczyk et al., 2015). The ongoing maturation of prefrontal brain regions responsible for executive

functioning coincides with increasing academic and social demands, creating a developmental context in which anxiety symptoms may have particularly pronounced effects on cognitive performance (Omotoso, 2007; Xie et al., 2021). This neurobiological reality means that understanding anxiety-cognition relationships during adolescence is critical and directly informs educational practices, clinical interventions, and policies

Adolescents experiencing persistent and severe symptoms of anxiety may face challenges across multiple cognitive domains, including attention, memory, problem-solving, and decision-making. Such impairments can potentially impede academic performance, social interactions, and overall well-being, thus highlighting the profound implications of anxiety-related cognitive dysfunction (Kajastus et al., 2024). This aligns with the Attentional Control Theory (ACT), which posits that anxiety does not affect cognitive processes uniformly (Eysenck et al., 2007). This framework proposes that anxiety symptoms disrupt executive attention mechanisms, namely inhibition, shifting, and updating, but leave cognitive processes relatively intact (Eysenck et al., 2007). This theoretical specificity is crucial because it suggests that anxiety's cognitive impact is selective rather than global, with important implications for educational accommodations and intervention strategies. When these selective impairments occur during adolescence, they can cascade into long-term academic difficulties, reduced educational attainment, and compromised life outcomes, making early identification and intervention essential.

Despite substantial evidence documenting anxiety-cognition relationships in Western populations, critical knowledge gaps persist regarding how these associations manifest in low- and middle-income countries (LMICs), and particularly within South African contexts. First, the overwhelming majority of anxiety-cognition research has been conducted in high-income countries with relatively homogeneous samples (Patel et al., 2016), leaving it uncertain whether the observed mechanisms generalise to populations experiencing chronic

multi-level adversity, characteristic of South African townships. Second, while anxiety prevalence among South African adolescents is documented (Cluver et al., 2016), few studies have examined its specific cognitive correlates using standardised neuropsychological batteries, creating an evidence gap regarding which cognitive domains may be most vulnerable. Third, the scant LMIC research that does exist has often employed Western-developed measures without adequate cultural adaptation or validation, potentially obscuring culture-specific manifestations of anxiety-cognition relationships. Finally, despite South Africa's unique position as an upper-middle-income country with extreme inequality, no published studies have specifically examined anxiety-cognition associations among KwaZulu-Natal's peri-urban adolescents, a population facing distinctive combinations of traditional and modern stressors, language diversity, and educational disparities. This study addresses these gaps by examining anxiety-cognition associations in a well-characterised South African sample using culturally adapted measures and a theoretically-informed framework.

In the South African context, adolescents face a range of unique systemic barriers and developmental challenges that may hinder their optimal development. Furthermore, they may increase their vulnerability to anxiety symptoms and change how these symptoms affect cognitive functioning. The persistent socioeconomic disparities, the enduring legacy of apartheid, and complex cultural dynamics create an environment fundamentally different from the Western, middle-class populations where most anxiety-cognition research has been conducted (Nyathi et al., 2024; Patel et al., 2024). In addition, exposure to violence, substance use, and health-related challenges such as high rates of Human Immunodeficiency Virus (HIV) infection and mental illness further compound these developmental risks (Zuma et al., 2022). This context matters because chronic exposure to environmental stressors may create adaptation effects that alter typical anxiety-cognition relationships, whilst limited

educational resources may interact with anxiety symptoms in ways not captured by existing theoretical frameworks (Arnsten, 2009; Evans, 2003; Lupien et al., 2007).

The significance of understanding anxiety-cognition relationships extends beyond individual outcomes to broader public health and development concerns. In low and middle-income countries like South Africa, mental health issues, including symptoms of anxiety, exert a disproportionate impact on the population, amplifying the urgency of addressing these concerns (Craig et al., 2022). Given these serious consequences that will impact broader society, it is essential to understand how symptoms of anxiety influence adolescent cognitive functioning in local contexts

This study addresses these critical gaps by systematically examining anxiety-cognition relationships among South African adolescents using Attentional Control Theory as a guiding framework. This research aims to contribute to both theoretical understanding and practical applications, potentially informing educational policies and intervention strategies.

1.2 Background to the research problem

A substantial body of research demonstrates that anxiety can significantly impair cognitive functioning through multiple mechanisms (Arnsten, 2009; McEwen, 2007; Robinson et al., 2013). Attention Control Theory provides a comprehensive framework for understanding these relationships (Eysenck et al., 2007). It proposes that anxiety disrupts executive processes such as inhibition, shifting, and updating, which impacts overall cognitive functioning (Eysenck et al., 2007). This theoretical specificity is crucial because it predicts that anxiety symptoms will not uniformly impair all cognitive domains but will selectively affect those requiring controlled, effortful processing whilst leaving automatic processes relatively intact (Eysenck et al., 2007). Anxiety disorders have been associated with reduced cognitive functioning, particularly in the domains of memory, processing speed,

and executive function, with these associations being more pronounced among younger individuals (Gulpers et al., 2022).

Despite increased global interest in adolescent mental health, much of the existing literature is based on clinical or high-income country samples. There remains a scarcity of research exploring the relationship between anxiety and cognitive functioning in non-clinical adolescent populations in low- and middle-income countries like South Africa (Castaneda et al., 2011). This is more than a simple research gap; it constitutes a critical barrier to understanding cognitive functioning under the conditions experienced by many adolescents. South African adolescents, in particular, experience chronic exposure to multiple stressors, including poverty, violence, and educational inequality, that may create neurobiological and psychological adaptations affecting anxiety-cognition relationships (Evans, 2003; McEwen, 2007, 2013). These adaptations could appear as enhanced resilience to anxiety symptoms (McEwen, 2013). This underscores the need for research in these groups, as existing theoretical models are incomplete, and interventions may be ineffective or unsuitable for them.

1.3 Rationale for the study

The purpose of this study is to gain a deeper understanding of the relationship between anxiety and cognitive performance, specifically in adolescents. Adolescence is a period where significant change occurs, leaving adolescents vulnerable to mental health problems, specifically increasing the risk of experiencing symptoms of anxiety (Özdemir et al., 2016; Powers & Casey, 2015). In the South African context, this vulnerability is further amplified by socio-economic disadvantage, exposure to violence, and under-resourced educational settings.

Although theoretical models such as Attention Control Theory suggest that anxiety disrupts executive control processes and reduces cognitive efficiency (Eysenck & Derakshan,

2011; Eysenck et al., 2007), there remains limited empirical evidence documenting how varying levels of anxiety symptoms relate to cognitive performance in non-clinical South African adolescents. This study seeks to address that gap by providing contextually grounded data on anxiety prevalence and its association with specific cognitive domains. By addressing this gap, the current study aims to provide a contextually grounded understanding of how varying levels of anxiety may affect cognitive performance in adolescents living in KwaZulu-Natal. The findings aim to inform targeted school-based mental health interventions, enhance educational support strategies, and contribute to broader policy efforts aimed at promoting adolescent well-being in South Africa. The relevance of Attentional Control Theory to the South African context is particularly acute because socioeconomic adversity itself operates as a persistent environmental threat stimulus. South African adolescents in peri-urban settings navigate chronic stressors such as poverty, community violence, household instability, and educational inequality that continuously activate stimulus-driven attentional processing (Barbarin & Richter, 2001; Cluver et al., 2016). According to ACT, such chronic activation depletes the executive control resources needed for goal-directed cognitive performance (Eysenck et al., 2007). This pathway suggests that socioeconomic adversity does not impair cognition directly, but rather through the anxiety it generates and the attentional competition that follows. Understanding this mechanism is central to the present study and carries direct implications for both assessment and intervention design in resource-constrained contexts.

1.4 Aims and objectives of the study

Aims

To determine the prevalence of mild and/or severe anxiety symptoms among a cohort of adolescents living in KwaZulu-Natal and to explore the impact of symptomatic anxiety on cognitive functioning.

Objectives

The following aims and objectives are grounded in the ACT framework and address the identified gaps in understanding anxiety–cognition associations among South African adolescents in peri-urban KwaZulu-Natal. Together they provide a coherent structure for the empirical investigation presented in the subsequent chapters.

The objectives of this study are:

a) To determine the prevalence of mild anxiety among a cohort of adolescents living in KwaZulu-Natal, South Africa.
b) To investigate the prevalence of severe anxiety among a cohort of adolescents living in KwaZulu-Natal, South Africa.
c) To explore whether the presence of mild anxiety symptoms is associated with reduced cognitive functioning among a cohort of adolescents living in KwaZulu-Natal, South Africa.
d) To determine whether the presence of severe anxiety symptoms is associated with reduced cognitive functioning among a cohort of adolescents living in KwaZulu-Natal, South Africa.

1.5 Research questions

This study was guided by the following research questions, which focus on a cohort of adolescents living in a peri-urban area of KwaZulu-Natal, South Africa. The key questions addressed in this research include:

1. What is the prevalence of mild and severe anxiety symptoms among this cohort of adolescents in KwaZulu-Natal?
2. Is the presence of mild or severe anxiety symptoms associated with impairments in cognitive functioning?

1.6 Definition of concepts

The following operational definitions provide working definitions for key constructs examined in this study:

Anxiety

Anxiety is a persistent feeling of worry, fear, or unease. It becomes clinically significant when it is excessive, difficult to control, and interferes with daily functioning (Gautam et al., 2022).

Cognitive function

Cognitive function is a broad term that encompasses mental processes involved in acquiring, processing, and utilising information, including attention, memory, executive functioning, and problem-solving (Kiely, 2014).

Executive functioning

Executive functioning refers to a set of higher-order cognitive processes that enable individuals to plan, focus attention, retain information, and manage multiple tasks effectively (Diamond, 2013). It comprises key components, including working memory, inhibitory control, and cognitive flexibility (Miyake et al., 2000)

Attention

Attention is a core cognitive function that allows individuals to selectively process relevant information whilst suppressing distractions. It is commonly described through three interacting networks: alerting, orienting, and executive control, which together support learning, memory, and goal-directed behaviour (Petersen & Posner, 2012).

Memory

Working memory refers to the ability to hold information in mind while mentally manipulating it. It enables individuals to relate pieces of information to one another and use that information to solve problems or make decisions (Diamond, 2013).

Learning

Learning is the process through which stable changes in the relationship between stimuli and responses are gradually formed, resulting from meaningful interactions with the environment as perceived through the senses. This process encompasses both cognitive and behavioural adaptations, which can occur either consciously or unconsciously, and in both structured and unstructured settings (Lachman, 1997).

Processing speed

Processing speed refers to the rate at which individuals can carry out automatic or straightforward cognitive tasks, especially under time constraints. It reflects how quickly one can perceive stimuli, process information, and generate appropriate responses (Wechsler et al., 2008)

Adolescence

Adolescence is the developmental transition between childhood and adulthood, characterised by biological, psychological, and social changes (Steinberg, 2014). Traditionally defined as spanning ages 10 to 19, more recent research has expanded this range to 10 to 24 years to reflect extended educational, social, and developmental transitions (Sawyer et al., 2018)

Non-clinical population

A non-clinical population refers to individuals who are not currently diagnosed with or receiving treatment for a psychological or medical condition (Kazdin, 2021; Marques et al., 2021).

Peri-urban area

Peri-urban areas refer to zones on the fringes of urban areas where rural and urban characteristics intersect. These areas are typically defined by rapid spatial expansion,

population growth, land-use change, and socio-economic diversity (Douglas, 2012; Wandl & Magoni, 2017).

1.7 Scope and limitations of the study

This study employed a cross-sectional design, which limits the ability to determine causal relationships between anxiety symptoms and cognitive performance (Levin, 2006).

Additionally, anxiety symptoms were measured using self-report instruments, which are vulnerable to response biases such as underreporting or overreporting (Paulhus & Vazire, 2007). Although efforts were made to control for significant confounding variables, unmeasured factors outside the scope of this study may have influenced cognitive performance (De Bellis & Zisk, 2014; Hackman et al., 2010).

1.8 Outline of the dissertation

Chapter 1 establishes the theoretical and practical significance of examining the association between anxiety and cognitive functioning among South African adolescents. It outlines the research aims, objectives, and questions, and discusses ethical considerations. The chapter concludes with an overview of the dissertation structure.

Chapter 2 systematically builds a comprehensive theoretical foundation by reviewing adolescent development within South Africa. It then explores the conceptualisation and experience of anxiety among adolescents, particularly within the South African context, including its prevalence and associated risk factors. The chapter further examines cognitive functioning during adolescence and synthesises research on the relationship between anxiety and cognitive performance. The ACT is used as the interpretive framework.

Chapter 3 outlines the research methodology employed in this study. It describes the overall research design, participant sampling procedures, data collection tools, and methods of data analysis whilst addressing cultural adaptation requirements. The ethical considerations related to the research process are also addressed.

Chapter 4 reports on the findings of the study. It presents the results of the data analysis, which is structured according to the research objectives, and includes both descriptive and inferential statistics relevant to the study's key questions.

Chapter 5 interprets the findings within the ACT framework and the existing literature, while considering South African contextual factors. Furthermore, it examines implications for theoretical development, educational policy, and clinical practice.

Chapter 6 concludes the dissertation. It summarises the main findings, reflects on the study's limitations, and provides recommendations for future research, as well as practical implications for mental health and educational interventions targeting adolescents.

1.9 Conclusion

This chapter has established the theoretical, empirical, and practical foundations for examining the association between symptoms of anxiety and cognitive functioning among South African adolescents within the ACT framework. The convergence of developmental vulnerabilities and environmental stressors during adolescence, combined with the limited context-specific research in low- and middle-income countries, underscores the need for further study. In South Africa, this presents an opportunity to develop a more nuanced understanding of how anxiety affects cognitive performance, contributing to both scientific knowledge and practical applications.

The following chapter provides a comprehensive review, systematically building from adolescent development through anxiety symptoms and cognitive functioning to the theoretical framework that will guide the interpretation of the findings.

Chapter 2

Literature review and theoretical framework

Introduction

This literature review builds a systematic foundation for examining the relationship between anxiety and cognitive functioning among South African adolescents within the framework of Attentional Control Theory (ACT).

This literature review will explore four interconnected themes that collectively justify the current investigation. First, adolescent development is explored with particular attention to the neurobiological vulnerabilities and environmental factors in South Africa. Second, anxiety symptoms are analysed, aiming to develop a comprehensive understanding of their conceptualisation both globally and within the specific context of South Africa. Third, cognitive functioning is defined, with emphasis on processes most relevant to ACT, which proposes that anxiety disrupts the balance between goal-directed and stimulus-driven attention, leading to reduced efficiency in executive functions such as inhibition, shifting, and updating. Finally, the review synthesises existing literature on the relationship between anxiety and cognitive functioning, drawing upon global and South African studies.

Through this integrated exploration, the review aims to contribute to a deeper understanding of the potential interplay between anxiety and cognitive functioning, ultimately informing future research and clinical interventions that promote the well-being of adolescents and enhance educational performance.

2.1 Adolescence

Adolescent development provides an essential foundation for interpreting the relationship between anxiety symptoms and cognitive functioning. This developmental period is marked by multiple factors that create vulnerability. These changes encompass a range of factors, including neurobiological vulnerabilities, environmental demands, and psychological

challenges. The following review of the adolescent period moves from global trends through South African-specific factors.

2.1.1 Overview of adolescent development

Adolescence is a dynamic period of life that bridges childhood and adulthood, characterised by significant biological, psychological, and social growth, development, and maturation (Özdemir et al., 2016; Sawyer et al., 2018). During this transition, children undergo sexual, physical, psychological, cognitive, and social changes that eventually transform them into adults (Özdemir et al., 2016). This phase also encompasses moral, identity-related, and mental developments (Özdemir et al., 2016; Powers & Casey, 2015).

Additional developmental perspectives support this characterisation. Steinberg (2014) emphasises the dual-systems model of adolescent brain development, highlighting the imbalance between a rapidly maturing socioemotional system and a more slowly developing cognitive control system. (Blakemore & Mills, 2014); Blakemore (2012) similarly document the protracted maturation of prefrontal regions and its implications for risk-taking and emotional regulation. Crone and Dahl (2012) further note that this developmental asymmetry creates windows of both vulnerability and plasticity that are particularly relevant in adversity-exposed populations.

While adolescence has traditionally been defined as spanning ages 10 to 19 years, contemporary perspectives extend this range to 10 to 24 years to better reflect modern patterns of growth, social role acquisition, and life transitions (Sawyer et al., 2018). Puberty is typically used as a biological marker to indicate the start of adolescence. Notably, research shows that the onset is occurring earlier than in previous generations, effectively fast-tracking the beginning of adolescence (Özdemir et al., 2016; Sawyer et al., 2018). Adolescence is a holistic developmental stage involving interconnected biological, social, cognitive, and emotional transformations that continue well beyond the completion of physical maturation

(Steinberg, 2014). Adolescence often involves adaptation difficulties and psychological challenges, characterised by crisis periods, transitions, and overall difficulty (Ahunovna, 2021).

It is crucial to understand these developmental changes as this period of significant change converges in ways that may amplify the association between anxiety symptoms and cognitive functioning(Steinberg, 2014). The following sections examine specific aspects of adolescent development that are most relevant to understanding anxiety-cognition relationships, beginning with the biological changes that create neurobiological vulnerability (Blakemore, 2012).

2.1.2 Biological changes and neurobiological vulnerability

Adolescence is initiated by puberty, a process driven by hormonal changes and the maturation of complex neuroendocrine systems. Central to this process is the activation of the hypothalamic-pituitary-gonadal (HPG) axis, alongside other hormonal shifts such as increased adrenal activity known as adrenarche, the onset of growth spurts, and gonadarche, which is the initiation of gonadal development triggered by pituitary gonadotropins (Dorn & Biro, 2011; Sawyer et al., 2018). Environmental factors, genetic factors, nutrition, living conditions, and mental health influence these biological processes. Consequently, the age and duration of adolescence vary (Özdemir et al., 2016).

Puberty, a key part of adolescence, is the period when reproductive capability becomes possible and is determined by an individual's biological age, rather than their chronological age. This typically occurs around a carpal age of 10 for girls and 11 years in boys, though it can range from ages 8 to 13 in girls and 9 to 14 in boys. In well-nourished populations, puberty typically begins around age 11 in girls and 13 in boys (Sawyer et al., 2018). Puberty is observed through menarche in females and spermarche, sperm ejaculation, in males (Dorn & Biro, 2011; Özdemir et al., 2016).

The early phase of adolescence is marked by rapid biological development. The skeletal system experiences rapid growth, and sexual maturation occurs (Özdemir et al., 2016).

Hormonal changes during this period drive both somatic and reproductive development (Remschmidt, 2013). Physical changes include increases in height and weight, the development of secondary sex characteristics, and changes in the distribution of fat and muscle tissue. In boys, the development of secondary sex characteristics includes growth of the testes and penis, development of pubic, axillary, and facial hair, voice deepening, and the onset of sperm cell production (Özdemir et al., 2016). In girls, the first signs are typically breast development, followed by the growth of pubic and axillary hair, and the onset of menstruation (Dorn & Biro, 2011; Özdemir et al., 2016). Structural and functional changes occur in all organ systems, and hormone levels increase significantly, which is evident in the external physical features (Remschmidt, 2013).

These physical changes mean that individuals of the same chronological age may look physically different from one another (Özdemir et al., 2016). However, while puberty brings physical maturity, adolescence extends beyond its completion. Many adolescents who appear physically mature have not yet developed the cognitive skills, emotional regulation, or behavioural maturity associated with adulthood (Özdemir et al., 2016). While these biological changes mark the physical transformation into adolescence, they also function as a foundation for significant social changes. The physical signs of puberty influence how adolescents are perceived, how they view themselves, and how they interact with their environment. These developmental changes initiate the social transformations that characterise adolescence.

The biological changes have significant implications for the anxiety-cognition relationship. The differential maturation rates of limbic and prefrontal systems create a

neurobiological context where anxiety responses may be heightened, whilst cognitive control mechanisms remain developing (Blakemore, 2012). This maturational imbalance means that adolescents may be particularly vulnerable to anxiety's disruptive effects on executive functioning, making this developmental period optimal for detecting anxiety-cognition relationships predicted by ACT (Blakemore, 2012).

2.1.3 Social Changes

Adolescence is a complex transitional stage in which individuals reach sexual maturity but still have limited rights and responsibilities, which affects their role in society (Remschmidt, 2013). This period marks a shift from dependence to independence, often through a phase of partial independence (Özdemir et al., 2016; Sawyer et al., 2018).

Historically, the completion of specific social role transitions signalled the end of adolescence. However, changes in social opportunities, increased access to contraception, and prolonged financial dependency on caregivers have extended the adolescent period well into the later years (Sawyer et al., 2018).

During this period, adolescents begin to assume social responsibilities, take on greater responsibilities, form new relationships, and develop a stronger sense of identity. This makes adolescence both an exciting and vulnerable period, as young people navigate increased self-awareness, question authority, and desire freedom (Ahunovna, 2021)

A notable shift occurs in adolescents' social environment, where friends are increasingly prioritised over family, and there is typically an increase in family conflict (Stringer, 1994). Adolescents may resist previously accepted expectations and experience frustration when their autonomy is limited (Ahunovna, 2021). Social status changes become more important, there is a heightened need for peer approval and conformity, and they begin to form new and diverse relationships (Ahunovna, 2021). These social changes take on particular significance in the South African context, where adolescents must navigate cultural

transitions whilst facing unique socioeconomic challenges. The shift toward peer relationships occurs within communities experiencing high levels of economic stress, violence exposure, and educational limitations that may amplify typical adolescent stressors.

These social changes become more significant in the South African context as adolescents navigate this period of transition while facing unique socio-economic challenges. The understanding of contextual factors is crucial for interpreting the anxiety-cognition relationships because chronic social stressors may modify typical patterns observed in other populations (Evans & English, 2002; Seedat et al., 2009).

2.1.4 Psychological changes

Psychological changes in adolescents are evidenced by the development of new cognitive structures that enable abstract thinking, understanding different perspectives, introspection, the establishment of moral values and norms, and the formation of personal and sexual identity (Remschmidt, 2013). Research indicates that adolescents often experience decreased self-esteem and conflicts between their self and their ideal self (Stringer, 1994). Typically, adolescents experience heightened self-consciousness, a sense of feeling different, and an increase in critical thinking, which can all contribute to this tension between selves (Steinberg, 2014).

These psychological changes can increase vulnerability to the experience of anxiety symptoms. Adolescents' capacity for abstract and hypothetical thinking begins to develop, enabling them to consider future possibilities and potential threats. However, their prefrontal cortex is still developing, and therefore, they have inadequate emotional regulation skills to manage these anxieties (Remschmidt, 2013). Furthermore, environmental stressors prominent in the South African environment can interact with their psychological vulnerabilities, impacting the cognitive functioning (McLoyd, 1998).

2.1.5 Cognitive changes

Cognitive development during adolescence is characterised by continued maturation of executive attention systems that are central to ACT's predictions about anxiety-cognition relationships. Although logical reasoning is generally fully mature by age 16, the refinement of executive functioning continues well into the twenties (Sawyer et al., 2018). This drawn-out development of the executive systems has profound implications for understanding the association between anxiety and cognition, because executive functions, according to ACT, are more vulnerable to anxiety interference (Eysenck et al., 2007).

The structures of the brain develop and reach maturation at different rates. The systems that mature earlier, such as the limbic system and the reward system, play a dominant role in the adolescent period (Remschmidt, 2013). The prefrontal cortex, which plays a dominant role in controlling emotions, matures later. This explains specific risky behaviour patterns often observed in adolescence. Additionally, there is an increased incidence of emotional disorders (Remschmidt, 2013). The increased hormone levels of gonadal steroids aid in brain restructuring. Furthermore, the brain continues to change through constant interaction between the individual and the environment, which may predispose adolescents to mental disorders (Remschmidt, 2013).

More positively, adolescence is a crucial period for brain development due to its heightened neuroplasticity, which suggests that intervention could be most effective during this period (Casey et al., 2008). Furthermore, it is essential to understand how anxiety symptoms impact cognitive development during this critical period, which can inform interventions.

2.1.6 Mental health vulnerability during adolescence

Adolescence is a developmental period marked by extensive changes and heightened emotionality, making this stage more susceptible to mental disorders compared to other life

stages, affecting up to one in five individuals (Powers & Casey, 2015; Remschmidt, 2013). Adolescence is emphasised as a critical period characterised by heightened susceptibility to environmental influences and significant shifts in brain development. This results in an imbalance between the rapidly evolving limbic circuitry and the more slowly developing prefrontal circuitry. This imbalance, compounded by genetic and environmental factors, may diminish emotional regulation capacity and elevate the risk of psychopathology (Powers & Casey, 2015). Adolescents' failure to regulate their emotional reactivity over time, despite there being no threat, puts them at an increased risk for anxiety and stress-related disorders (Powers & Casey, 2015). This is particularly concerning from an ACT perspective, as an increase in vulnerability to anxiety symptoms will likely impair executive functioning. Executive functioning is crucial for both academic success and social development (Remschmidt, 2013). The combination of heightened anxiety vulnerability and a more vulnerable executive functioning system may lead to more pronounced symptoms or longer-lasting effects.

The decision to focus specifically on adolescents in KwaZulu-Natal warrants explicit justification grounded in South African evidence. First, KwaZulu-Natal bears a disproportionate mental health burden: provincial data indicate elevated rates of anxiety and depression among adolescents, linked to high exposure to violence, HIV-affected households, and poverty-related stressors (Govender et al., 2020). Second, South African research documents that most lifetime mental disorders emerge before age 18, yet treatment-seeking rates remain low due to stigma and access barriers (Kleintjes et al., 2006), making early identification in adolescence particularly critical. Third, adolescence in South Africa is characterised by the convergence of normative developmental demands with structural disadvantages absent from contexts where ACT was developed, creating a uniquely high-risk period that international literature may underestimate (Richter et al., 2017). Finally, the peri-

urban setting of the Asenze Study captures a population navigating rapid urbanisation and cultural transition that is understudied relative to both rural and metropolitan South African populations.

2.1.7 Socioeconomic and environmental challenges facing adolescents in South Africa

Adolescents in South Africa face a myriad of socioeconomic challenges that significantly impact their development and mental health. These challenges distinguish their experience from populations where most anxiety-cognition research has been conducted. It is crucial to understand these contextual factors because chronic environmental stressors may create an adaptation effect, modify the presentation of anxiety, reduce baseline cognitive capacity, or alter or limit cognitive processes that are most vulnerable to anxiety interference (Arnsten, 2009; Lupien et al., 2009; McEwen, 2007).

2.1.7.1 Poverty

The consequences of poverty are well-documented. It is not poverty itself that directly harms development. Instead, it is the numerous risk factors associated with poverty that have a harmful impact (Jensen et al., 2017). These factors include food insecurity, poor health, limited access to services, and chronic psychological stress (Huston & Bentley, 2010; Jensen et al., 2017). Collectively, these factors contribute to the adverse developmental outcomes observed in children living in poverty (Jensen et al., 2017).

Poverty impacts development in multiple ways. Food insecurity can lead to malnutrition and negatively impact physical and cognitive development (Chilton et al., 2007). There is a lack of material resources and opportunity for cognitive stimulation and growth, which are crucial mediators in fostering optimal development in children (Huston & Bentley, 2010). Research suggests that children from poor socioeconomic backgrounds often perform significantly below children from middle-class backgrounds at school and have a poor

educational attainment rate. Additionally, a lack of access to proper and timely medical care may lead to poorer health and, therefore, vulnerability to illness and disease.

Poverty creates chronic stress for individuals. This stress can impede successful adjustment to developmental tasks. Furthermore, poverty experienced throughout childhood and adolescence can negatively impact emotional development (Huston & Bentley, 2010).

Adolescents adapted to ongoing environmental threats may show different patterns of anxiety-cognition relationships than those observed in more secure environments. Additionally, the cognitive demands of navigating poverty-related stressors may interact with anxiety symptoms in ways not captured by research conducted in well-resourced populations (Evans & English, 2002; Lupien et al., 2009)

2.1.7.2 HIV epidemic

The HIV epidemic in South Africa also poses significant challenges for adolescents, with many affected by the virus either directly or indirectly. Adolescents living with HIV may experience cognitive impairments, developmental delays, and concentration difficulties, and have a greater chance of developing mental illnesses such as depression, anxiety, and substance abuse (Flisher et al., 2012). Moreover, adolescents face various psychosocial challenges related to HIV, including coping with the loss of biological parents, grappling with their HIV-positive status, and dealing with identity issues, external stigma, discrimination, and disclosure struggles (Petersen et al., 2010). The HIV epidemic creates unique considerations for anxiety-cognition research because HIV can directly affect cognitive functioning, whilst also increasing anxiety symptoms through social stigma and health concerns. Understanding how HIV-related factors interact with anxiety symptoms to affect cognitive performance is crucial for developing appropriate interventions in South African contexts (Flisher et al., 2012; Petersen et al., 2010)

2.1.7.3 Substance abuse

Substance abuse is highly prevalent in South Africa, with a significant proportion of individuals affected being under the age of 20. The co-occurrence of substance use disorders with other mental health conditions often compounds this issue (Flisher et al., 2012). Research indicates that adolescents who use substances such as alcohol and marijuana exhibit notable abnormalities in brain functioning. These include changes in brain structure volume, white matter integrity, and responses to cognitive tasks (Squeglia et al., 2009). Furthermore, substance abuse can disrupt emotional and behavioural patterns, leading to adverse personal and familial outcomes (Lander et al., 2013). Substance abuse is particularly relevant to anxiety-cognition research because substances can independently affect executive attention whilst also serving as maladaptive coping strategies for anxiety symptoms.

2.1.7.4 Violence and crime

Interpersonal violence is the primary cause of injury in South Africa, with the country's homicide rate over seven times the global average. This exposure to violence and crime contributes to chronic stress, anxiety, and depression among adolescents, impeding their ability to focus on education and personal growth (Pillay et al., 2024; Ward et al., 2012). Adolescents in South Africa are frequently exposed to violence and crime, with sexual harassment and violence posing a pervasive threat. Many adolescents experience violence, abuse, and neglect within their own homes, while concerns about local gangs, physical violence, and substance abuse add to their challenges (Scorgie et al., 2017). A high degree of victimisation can lead to psychological maladjustment (Sui et al., 2021). Chronic exposure to violence and crime creates sustained activation of threat detection systems that may fundamentally alter anxiety-cognition relationships. Adolescents adapted to high-threat environments may show heightened baseline vigilance that affects attention allocation, potentially masking or amplifying anxiety's typical effects on executive attention (Lupien et

al., 2009). Understanding these adaptation effects is crucial for interpreting anxiety-cognition relationships in South African populations.

2.1.7.5 Teenage pregnancy

Teenage pregnancy is another problem faced by many South African adolescents. This is evidenced by the high rate of teenage pregnancy in South Africa. This is accompanied by psychological, social, and economic difficulties (Maputle et al., 2015). Teenage pregnancy and childbirth are linked to increased adverse health and well-being outcomes for both the baby and mother (Paranjothy et al., 2009). Teenage motherhood can harm the psychological development of infants. Additionally, female infants born to adolescent mothers are at a higher risk of becoming teenage mothers themselves, perpetuating the cycle of teenage pregnancy and its associated consequences (Rachakonda et al., 2014).

2.1.7.6 Implications for anxiety-cognition relationships

These contextual factors collectively create a developmental environment that is fundamentally different from those in which ACT was developed and validated. Chronic exposure to stress may create adaptation effects, which may mean anxiety does not impact individuals normally and therefore may not impact cognition in the way that ACT predicts. Anxiety symptoms may have less of an effect as individuals develop coping mechanisms to manage this ongoing, chronic stress (Luthar, 2015; Rutter, 2012). These socioeconomic factors may also impact cognition and, therefore, may not only be impacted by anxiety, and finally, the threshold for anxiety effects may be higher because baseline stress adaptation creates resilience to additional stressors (McEwen, 2006). After setting the contextual scene of the particular vulnerabilities associated with growing up in South Africa, it becomes clear how important it is to understand how anxiety symptoms may exploit these vulnerabilities to affect cognition.

2.2 Anxiety

An understanding of anxiety symptoms, their manifestations, prevalence, and cultural expression will provide the foundation for examining how these symptoms may affect cognitive functioning among South African adolescents. This section builds upon conceptual foundations by considering cultural aspects, examining predisposing factors and prevalence patterns. This established anxiety symptoms as a significant concern requiring theoretical understanding and practical intervention.

2.2.1 Conceptualising anxiety symptoms

Anxiety symptoms represent a complex psychological phenomenon characterised by persistent worry, nervousness, and unease about potential future threats or adverse outcomes (McTeague & Lang, 2012). It disrupts standard emotional processing, often leading to heightened responses to stimuli that are mildly threatening or even non-threatening. Unlike fear, which arises as an immediate response to a clear and present danger, anxiety is a diffuse, future-oriented state that anticipates potential adverse outcomes without a distinct source (Craske et al., 2011; Rachman & Rachman, 2013).

Anxiety symptoms manifest across multiple domains, presenting a complex interplay of emotional, physiological, cognitive, and behavioural symptoms. Emotionally, individuals often experience internal distress, characterised by feelings of fear, dread, and panic. Physiologically, anxiety triggers visceral and somatic responses such as increased heart rate, sweating, and muscle tension. Cognitively and behavioural symptoms include avoidance, hypervigilance, compulsive behaviours, and attentional difficulties (Lang & Cuthbert, 1984; McTeague & Lang, 2012)

The Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5) provides operational criteria for identifying clinically significant anxiety symptoms. Generalised Anxiety Disorder is characterised by persistent and overwhelming feelings of

worry and apprehension occurring more days than not for at least six months, accompanied by at least three additional symptoms: restlessness, fatigue, concentration difficulties, irritability, muscle tension, or sleep disturbances (American Psychiatric Association, 2013). Additionally, these anxious feelings or associated symptoms result in considerable distress or hindrance in daily functioning (American Psychiatric Association, 2013).

From an ACT perspective, difficulties with concentration are particularly significant as they directly reflect how anxiety may impact an individual's executive attention processes, which are central to cognitive functioning. The conceptualisation of anxiety symptoms as involving attention and concentration difficulties aligns directly with ACT's predictions about anxiety-cognition relationships. If anxiety symptoms inherently involve attentional disruption, this provides a theoretical mechanism for understanding how anxiety affects cognitive performance across different domains and populations.

2.2.2 The experience of anxiety symptoms in South Africa

Anxiety is a universal experience, but cultural factors significantly influence both its experience and expression. Two primary components contribute to these diverse manifestations: ethnopsychological factors and contextual factors. Ethnopsychological factors arise from individuals' interpretations of symptoms and psychological cues, while contextual factors shape the outward expression of anxiety within specific social contexts and according to prevailing norms (Hinton & Patel, 2017).

Symptoms of anxiety are perceived, manifested, and expressed differently across different cultures (Sweetland et al., 2014). Some populations may experience somatic symptoms, while others experience more cognitive symptoms, which may change which cognitive domains are more vulnerable to anxiety interference across cultures (Hinton & Patel, 2017). Cultural and linguistic nuances play a significant role in the experience of anxiety. In many African languages, there is no direct equivalent to the term "anxiety",

reflecting how mental disorders are conceptualised and expressed differently across cultures (Sweetland et al., 2014). Research has indicated that among the Khwe of South Africa, "thinking a lot" has multiple meanings and associated experiences (Den Hertog et al., 2016). "Thinking too much" is an idiom of distress that encompasses a range of psychological and emotional states, including both brief and chronic conditions, as well as feelings of sadness, worry, and hopelessness (Den Hertog et al., 2016). In Sesotho speakers, the main difference in the manifestation of anxiety compared to Westerners is the experience of perceptual disturbances, which are usually indicative of psychosis in the Western world. The primary symptoms of anxiety expressed by Sesotho speakers are poor concentration, headaches, and dizziness (Mosotho et al., 2011). These cultural variations in anxiety symptoms experience and expression have profound implications for anxiety-cognition research because they suggest that cognitive processes affected by anxiety may vary across cultural contexts.

A study examining anxiety symptoms in South African children revealed that they experienced higher levels of anxiety than Western children (P. Muris et al., 2002). White South Africans displayed lower levels of anxiety compared to black South Africans. These high levels of stress may stem from the lasting impact of apartheid, which has left significant disparities and a legacy of deprivation, violence, inadequate healthcare, and poor education affecting black South Africans more acutely (P. Muris et al., 2002).

Furthermore, in a third-world country such as South Africa, due to the high exposure to stress, individuals may develop resilience towards this stress. This is referred to as stress inoculation, and the consequences of this phenomenon are that individuals who experience chronic exposure develop coping mechanisms and resilience to the stressors. This may result in a normalisation of what stress and anxiety feel like and may make it difficult to detect through screening tools as individuals become used to the stress. It is considered their norm and not a deviation from healthy functioning. This goes further and can impact individuals at

a neurobiological level, creating a new baseline due to the allostatic load (Luthar, 2015; McEwen, 2013; Rutter, 2012).

2.2.3 Anxiety symptoms during adolescent development

Mild anxiety symptoms represent normative aspects of human experience, particularly during adolescence when multiple developmental stressors converge. However, symptoms become concerning when their intensity, duration, or functional impact exceeds developmentally appropriate levels, interfering with academic performance, social relationships, or psychological well-being (Bhatia & Goyal, 2018) The distinction between normative and concerning anxiety symptoms is crucial during adolescence because this developmental period involves numerous anxiety-provoking transitions that may temporarily elevate symptom levels without indicating pathology (Xie et al., 2021).

Childhood symptoms of anxiety can result in adverse psychopathological outcomes and an increased risk for mental health problems in adulthood. Furthermore, anxiety can lead to functional impairment and psychosocial consequences, contributing to difficulties across various domains of an individual's life (Bhatia & Goyal, 2018; Spence, 2018).

Research highlights that anxiety symptoms often emerge in early adolescence, with many adults reporting onset before age 15 (Narmandakh et al., 2021; Spence, 2018). While many adolescents do not meet the full diagnostic criteria for anxiety, they still experience impaired functioning in various domains. They are at risk for progression to a clinical anxiety disorder (Spence, 2018). Anxiety disorders are one of the most prevalent mental health problems among young children and adolescents. A recent meta-analysis, including 41 studies conducted across 27 countries with 63,130 children and adolescents, revealed a prevalence rate of 6,5 % (Spence, 2018). Globally, anxiety disorders rank among the most prevalent mental health issues in children and adolescents (Spence, 2018). In sub-Saharan Africa, where adolescents constitute approximately 23% of the population, data on mental

health disorders, particularly in South Africa, remain scarce, underscoring the urgent need for further research to address this gap (Mkhize et al., 2024).

2.2.4 Risk factors for anxiety symptom development

The following examination of risk factors considers both universal patterns and South African-specific factors that may influence the development and expression of anxiety symptoms.

2.2.4.1 Genetic Factors

Anxiety disorders often have a familial pattern, with individuals who have a first-degree relative suffering from an anxiety disorder being four to six times more likely to develop anxiety themselves compared to those without such a family history (Gordon & Hen, 2004). Twin studies have further highlighted the significant role of genetics in familial risk, estimating that 20% to 50% of an individual's risk of developing an anxiety disorder can be attributed to genetic factors (Gordon & Hen, 2004). Research suggests that multiple genetic loci influence anxiety (Friligkou et al., 2024)

2.2.4.2 Biological Factors

There is substantial evidence that females are more at risk than males for developing symptoms of anxiety (Altemus, 2006; Mkhize et al., 2024). Moreover, the strongest predictor for the onset of anxiety is being female (Narmandakh et al., 2021). The difference in prevalence between sexes is evident in multiple countries and cultures, suggesting a biological basis (Altemus, 2006). Women experience greater fluctuations in their hormones across their lifespan, which impact and alter brain structure and function (Narmandakh et al., 2021). These likely play a role in the increased prevalence of anxiety disorders in women (Altemus, 2006). Furthermore, puberty appears to initiate neural and social changes that converge and together impact an adolescent's propensity for developing internalising disorders like anxiety, and this is particularly relevant in female adolescents (Pfeifer & Allen,

2021). In addition, adolescents older than 15 years are at a higher risk of developing anxiety (Mkhize et al., 2024).

2.2.4.3 Personality Traits

Personality traits have been strongly associated with anxiety disorders, particularly neuroticism and extraversion (Brandes & Bienvenu, 2006). Neuroticism refers to the tendency to experience negative emotions and difficulty coping with stress, while extraversion relates to the desire for social interactions and the experience of positive emotions (Brandes & Bienvenu, 2006). Individuals high in neuroticism and low in extraversion often report greater feelings of anxiety, sadness, and vulnerability. These traits are relatively independent of each other, and an individual can be high in both, low in both, or high in one and low in the other. Their interplay and different combinations can influence susceptibility to anxiety disorders (Brandes & Bienvenu, 2006). Additionally, low self-esteem is associated with symptoms of anxiety (Holmqvist Larsson et al., 2020).

2.2.4.4 Environmental Factors

Environmental factors play a significant role in the aetiology of anxiety (Bhatia & Goyal, 2018). Environmental factors, such as being in a higher grade in school and engaging in cannabis use, were significantly linked to adolescents experiencing anxiety (Mkhize et al., 2024). Mental health outcomes in general are negatively affected by traumatic experiences, exposure to violence, socio-economic factors, parenting practices, and engagement in risky behaviours such as risky sexual behaviour, violence, and self-harm. These behaviours become more prevalent during the adolescent years. Thus, putting adolescents at a greater risk for experiencing symptoms of anxiety and other mental health disorders (Mkhize et al., 2024).

2.2.4.5 Psychosocial Factors

A combination of familial, social, and environmental factors interacts in complex ways to influence the development of anxiety. The interplay of these factors, especially when multiple risk factors are present, significantly increases the risk of developing anxiety disorders (Hyland et al., 2016). These include a parental history of anxiety, advanced parental age, gender, urban living, economic deprivation, family dissolution, and childhood adversities (Hyland et al., 2016). Furthermore, behavioural inhibition and peer victimisation were found to be risk factors (Wichstrom et al., 2013). The accumulation of multiple risk factors tends to have the most detrimental impact (Hyland et al., 2016). In the South African context, psychosocial risk factors take on particular significance because many adolescents experience multiple concurrent stressors. This accumulation of psychosocial risk factors may create chronic stress conditions that modify typical anxiety-cognition relationships (Guidi et al., 2021).

2.2.5 Prevalence of anxiety

2.2.5.1 Global prevalence of anxiety

A systematic review conducted in 2013 assessed the prevalence of anxiety disorders across 44 countries through a comprehensive analysis of 87 studies. The global prevalence of anxiety disorders was determined to be 7.3% (Baxter et al., 2013). The World Health Organisation (2023) estimated that 4% of the global population currently experiences an anxiety disorder, highlighting it as one of the most prevalent mental disorders. Similarly, Javaid et al. (2023) found that an estimated 4,05% of the global population experienced an anxiety disorder. These results are similar to international studies where the prevalence of Generalised Anxiety Disorder (GAD) was found to be 4,5% in adolescents in a Norwegian study and a Worldwide pooled prevalence study (Polanczyk et al., 2015; Steinsbekk et al., 2022). Individuals suffering from an anxiety disorder have increased by more than 55% over

the past 30 years (Javaid et al., 2023). A more recent pooled prevalence of several global systematic reviews found the prevalence of anxiety was between 13% and 19% (Mkhize et al., 2024).

The global prevalence of anxiety highlights the urgent need to understand its impact on different areas of functioning, including cognitive functioning. With a significant portion of the global population currently affected and statistical trends suggesting continued increases in the prevalence, it is crucial to explore the broader consequences of anxiety to address its growing burden.

2.2.5.2 Prevalence of anxiety in South Africa

Middle-income countries like South Africa face a disproportionate burden of mental health issues (Craig et al., 2022). Despite this, individuals from low socioeconomic backgrounds are often less likely to report symptoms of anxiety, potentially due to stigma, lack of awareness, or limited access to healthcare (American Psychiatric Association, 2013). The inadequate mental health services in low- and middle-income countries exacerbate this problem, leading to many mental health conditions going undiagnosed and untreated (Mkhize et al., 2024). In South Africa, the prevalence of anxiety is notably concerning. A 2018 study revealed that one in five women living in urban informal settlements reported moderate to severe symptoms of anxiety (Mkhwanazi & Gibbs, 2021). Similarly, a separate study found that 17.8% of the 3,402 respondents' GAD-7 results indicated probable anxiety (Craig et al., 2022). Among adolescents, the issue is equally pressing; Mkhize et al. (2024) found that 20.9% of 621 adolescents based in the Western Cape reported anxiety symptoms that could be indicative of a clinical diagnosis. Another study confirmed that 17.8% of 302 adolescents experienced moderate to severe anxiety symptoms (Marlow et al., 2023). Particularly alarming are the findings from a study of South African student nurses, where 74.7% exhibited symptoms indicative of an anxiety disorder (Manana et al., 2023). While the

literature on the prevalence of anxiety in South Africa is still emerging, the data available unmistakably highlight anxiety as a significant issue in the country, warranting further investigation.

The following section considers cognitive functioning, a domain that may be shaped by anxiety symptoms, to build a fuller picture of how these relationships manifest in this population.

2.3 Cognitive Functioning

Cognitive functioning refers to the intricate processes of the brain in which it acquires, processes, stores, and retrieves information. These processes ultimately influence an individual's ability to perceive, understand, and interact with the world. Cognitive functioning encompasses a range of abilities across various domains, including executive functioning, attention, learning and memory, problem-solving, and decision-making (Robinson et al., 2013; Sachdev, 2014).

2.3.1 Executive functioning

Executive functions are advanced, higher-order cognitive processes crucial for guiding and optimising behaviour, particularly in novel or complex situations (Salehinejad et al., 2021). They are critical for self-directed behaviour such as self-regulation, which allows individuals to set goals, develop strategies, and manage their actions efficiently (Salehinejad et al., 2021).

Three core executive functions, namely inhibition, shifting, and updating, play complex and important roles in executive tasks. Inhibition refers to the ability to suppress or override a dominant or automatic behavioural response in favour of a more goal-directed action. (Banich, 2009; Miyake et al., 2000). Shifting refers to the flexibility to move between different mental operations. (Banich, 2009; Miyake et al., 2000). Updating involves monitoring, revising, and replacing information in the working memory with more relevant

information. (Miyake et al., 2000). Executive functions are vital for managing daily routines, achieving long-term goals, and adapting to changing circumstances. (Salehinejad et al., 2021).

Notably, empirical research has identified relationships between executive functions and scholastic achievement. Inhibition, shifting, and updating have each been associated with performance in key domains, demonstrating the central role that executive processes have in supporting cognitive performance (St Clair-Thompson & Gathercole, 2006). Furthermore, ACT posits that anxiety disrupts inhibition, shifting, and updating, thereby reducing the efficiency of executive control. This provides a valuable theoretical foundation for understanding how anxiety may compromise cognitive performance and, consequently, educational outcomes (Eysenck et al., 2007; St Clair-Thompson & Gathercole, 2006).

2.3.2 Attention

Attention is a critical cognitive function that operates through three distinct but interacting networks: alerting, orienting, and executive control (Petersen & Posner, 2012; Posner & Petersen, 1990). The executive attention network is significant for investigating the anxiety-cognition association because this network plays an important role in suppressing irrelevant information, and according to ACT, it is vulnerable to anxiety interference (Eysenck et al., 2007).

There are two primary frameworks within the attentional network: top-down and bottom-up attention. Top-down attention involves selective processing where the brain prioritises information according to individuals' goals, expectations, and internal motivations (Krauzlis et al., 2023). It is a voluntary allocation of attention and can be typified as endogenous or sustained attention, where focus is maintained over extended periods (Pinto et al., 2013).

In contrast, bottom-up attention is driven by external stimuli and involuntarily catches the individual's attention, often regardless of the individual's current goal (Krauzlis et al., 2023). It is often referred to as exogenous or transient attention. It is crucial to respond quickly to potential threats or novel stimuli, ensuring that individuals can react to significant changes in their surroundings (Pinto et al., 2013).

Both top-down and bottom-up attentional mechanisms ultimately enable individuals to analyse, interpret, and respond to the selected stimuli, thereby improving cognitive efficiency and behavioural responses (Pinto et al., 2013). Anxiety is theorised to disrupt the balance between these two mechanisms by increasing the bottom-up system and reducing the top-down system, leading to ineffective attention overall (Eysenck et al., 2007).

From an ACT perspective, the critical insight is that anxiety pathologically weights the balance between these two systems. Under conditions of elevated anxiety, threat-relevant stimuli, whether external (environmental danger cues) or internal (worrisome thoughts), automatically capture bottom-up attention. Because total attentional capacity is finite, this automatic capture necessarily reduces the resources available to the top-down, goal-directed system. The practical consequence is that anxious individuals must expend greater cognitive effort to achieve equivalent task performance, a phenomenon ACT terms reduced processing efficiency (Eysenck et al., 2007). In adolescents, whose top-down attentional control is still maturing (Blakemore & Mills, 2014). This competition is expected to be particularly disruptive, as they have fewer executive resources in reserve compared to adults.

2.3.3 Memory systems and learning processes

Memory and learning are fundamental cognitive processes that form the foundation of human experience and knowledge acquisition. These processes involve the complex interplay of various brain networks, which work together to encode, store, and retrieve information (Brem et al., 2013). Learning is the process of acquiring knowledge, enabling individuals to

adapt to new situations, solve problems, and develop skills over time. Memory refers to the retention of that knowledge, leading to changes in behaviour resulting from an experience (Squire, 2004).

Memory is typically categorised into different types based on the nature of the information being processed and how it is stored. Declarative memory involves conscious recollection of facts and events, enabling comparison and contrast, and is critical for recalling specific information (Coray & Quednow, 2022; Okano et al., 2000). This type of memory is further divided into episodic memory, which pertains to personal experiences and specific events, and semantic memory, which relates to general knowledge and facts about the world (Coray & Quednow, 2022). These types of memory are very similar and use similar brain structures and neuronal substances during formation (Coray & Quednow, 2022).

Procedural memory, a type of non-declarative memory, involves the unconscious acquisition and retention of skills and habits (Okano et al., 2000). This form of memory typically develops gradually through repeated practice, leading to the automatic and efficient execution of tasks (Okano et al., 2000).

Working memory is a core executive function that plays a critical linking role between learning and long-term memory (Diamond, 2013). It functions as a limited-capacity storage system that temporarily holds and manipulates information (Baddeley, 2012; Diamond, 2013). There are two types of working memory: verbal and nonverbal. Working memory provides the immediate workspace necessary for encoding, rehearsing, and retrieving information. Through this role, working memory serves as a gateway for learning, influencing how effectively information is consolidated into episodic, semantic, or procedural memory systems (Cowan, 2017; Diamond, 2013).

Significantly, working memory depends on inhibitory control to suppress irrelevant information so that task-relevant information can be used (Diamond, 2013). ACT postulates

that anxiety disrupts attention, which weakens inhibitory control. This results in an overload of information, which reduces the efficiency of the working memory (Diamond, 2013).

2.3.4 Problem-solving and decision-making

Problem-solving is a multifaceted cognitive process that involves identifying, analysing, and resolving issues to achieve a desired outcome. It involves several steps and techniques that help individuals find practical solutions to complex problems (Jonassen, 2010). This process is integral to human functioning, as it enables individuals to navigate challenges, make informed decisions, and implement strategies that lead to practical solutions (Mayer & Wittrock, 2006).

Decision-making is a critical cognitive function that involves evaluating alternatives and choosing a course of action among competing options (Baron, 2023). The ability to make effective decisions is integral to achieving desired outcomes. Decision-making typically involves several stages. The first stage involves identifying the decision to be made, which requires recognising a need or opportunity for action (Baron, 2023). The second stage involves gathering relevant information, which includes collecting data, understanding the context, and identifying constraints and limitations (Kahneman, 2011). The third stage involves evaluating potential options, where the decision-maker considers various alternatives based on established criteria or preferences (Baron, 2023). Once the alternatives have been evaluated, the fourth stage involves making a choice. This stage requires the decision-maker to commit to one of the options and plan the course of action (Baron, 2023). The final stage of the decision-making process involves implementing the chosen option and monitoring the results (Baron, 2023).

2.3.6 Adolescent cognitive development

Cognitive development in adolescence is characterised by maturation of certain areas in the brain and development in executive functions, social cognition, and language

development (Ciccia et al., 2009). Two significant neural changes occur during puberty. Myelination increases the speed of neural transmissions and supports the development of higher-order functions. Secondly, synaptic pruning occurs, which strengthens the most used connections. These processes ultimately optimise brain efficiency. This makes adolescence a vulnerable period, as adolescents who are repeatedly exposed to stress and form neural pathways that are linked to this anxiety may reinforce these pathways (Dow-Edwards et al., 2019).

Executive functions form the basis of metacognitive skills. They control other cognitive functions such as self-control, abstraction, temporal estimation, and sequencing. Executive functions continue to develop through adolescence. In essence, adolescence can be characterised by qualitative shifts in executive functions, which then combine with increased speed and capability to cope with multiple, conflicting stimuli (Ciccia et al., 2009).

Key cognitive abilities develop further throughout adolescence, including inhibitory control, process speed, working memory, and decision-making (Blakemore, 2012).

Social cognition refers to the cognitive processes that are specific to social functioning. This develops throughout adolescence into adulthood and involves multiple social abilities, including theory of mind, which is the ability to infer how others feel and to interpret their behaviours. Social cognition is essential for effective communication, empathy, and the formation of social relationships. During adolescence, individuals become increasingly adept at understanding and interpreting social cues, managing complex social dynamics, and navigating peer relationships (Ciccia et al., 2009).

Significant language development occurs during adolescence. Adolescents begin to master the form, content, and use of language. There is evidence to suggest that improvements in language processes reflect an enhancement in working memory, abstraction, and cognitive flexibility. Furthermore, adolescents learn to regulate their verbal behaviour

and use language to negotiate and achieve complex goals. These cognitive abilities rely on environmental support to fully mature (Ciccia et al., 2009).

Cognitive impairment represents a significant challenge for adolescents, exerting profound effects across various spheres of their lives. Adolescents with impaired cognitive performance may struggle to maintain attention, retain information, and exercise executive functions that are critical for academic success. It is imperative to recognise the broad-ranging impact that cognitive challenges can have on individuals of all age groups. Cognitive impairments may, in turn, jeopardise their prospects for autonomy, financial stability, and overall well-being as they begin to navigate the complexities of adulthood (Robinson et al., 2013).

Having established cognitive functioning as a multifaceted domain with particular vulnerabilities during adolescence, the following section examines empirical research on anxiety-cognition relationships, building toward the theoretical framework that best explains these complex patterns.

2.3.7 Environmental influences on cognitive development

Environmental factors play a crucial role in cognitive development. In KwaZulu-Natal, South Africa, there are multifaceted stressors that have the potential to negatively impact neurocognitive development, particularly in domains requiring sustained attention, executive control, and complex problem-solving abilities. The cumulative impact of these environmental factors could negatively impact cognitive functioning.

2.3.7.1 Early life and prenatal factors

Neurodevelopmental trajectories are shaped by early-life adversity and prenatal conditions, such as inadequate maternal nutrition and elevated levels of prenatal stress, which can impair foetal brain development, with long-lasting implications for cognitive functioning (Graham et al., 2022; Lupien et al., 2009; Monk et al., 2012). In South Africa, high levels of

poverty and chronic stress increase the likelihood of premature birth, low birth weight, and other complications known to negatively impact neurodevelopment (Goldenberg et al., 2008). Substance abuse during pregnancy is another significant concern in low socioeconomic environments. Substance abuse further undermines neurodevelopment (Calling et al., 2019; Fjortoft et al., 2024; Ranjbaran et al., 2018).

2.3.7.2 Socioeconomic and environmental influences

The structural inequalities in South Africa perpetuate limited access to quality education, enriching experiences, and resources that support cognitive development. Research demonstrates that low socioeconomic status is a significant predictor of poorer cognitive function (Das-Munshi et al., 2016; Lund et al., 2010; Mutola et al., 2023). Children growing up in poverty face compounding risks, including malnutrition, neglect, and trauma, which alter neurobiological processes and impair cognitive functioning (Koshy et al., 2024; McEwen, 2007; McLaughlin et al., 2019; Teicher & Samson, 2016). Additionally, the daily demands of survival in such contexts may reduce motivation to engage in cognitively enriching activities, further impeding developmental progress (Morgado & Cerqueira, 2018; Sousa, 2016).

2.3.7.3 Role of early childhood stimulation

Early childhood stimulation plays a vital role in healthy brain development, laying the foundation for learning, emotional regulation, and interpersonal skills later in life (Richter et al., 2017). However, in resource-limited settings, caregivers frequently encounter substantial barriers to providing these enriching experiences. Socioeconomic pressures such as poverty, unemployment, and food insecurity may force caregivers to prioritise basic survival needs over fostering cognitive engagement (Richter et al., 2017). Malnutrition, lack of stimulation, and psychosocial deprivation in early childhood are strongly correlated with poorer cognitive outcomes throughout development (Walker et al., 2007). Additionally, restricted access to

early learning materials, quality childcare, healthcare, and safe play environments further restricts opportunities for cognitive stimulation (Black et al., 2017). These constraints can contribute to developmental delays and further widen the cognitive gap between children from affluent and disadvantaged backgrounds (Daelmans et al., 2017; Li et al., 2023).

2.3.7.4 Impact of HIV and AIDS in KwaZulu-Natal

In KwaZulu-Natal, the high prevalence of Human Immunodeficiency Virus (HIV) and Acquired Immune Deficiency Syndrome (AIDS) introduces additional challenges. HIV infection is associated with neurological impairments, especially when adherence to antiretroviral treatment (ARV) is inconsistent (Uwishema et al., 2022). Structural barriers often impede regular access to medication, further compromising treatment efficacy and increasing vulnerability to cognitive deficits (Kagee et al., 2011; Lankowski et al., 2014). Beyond the direct effects of HIV, adolescents frequently assume caregiving roles within households following the loss of their parents, compounding stress and further limiting opportunities for optimal cognitive development. (Fauk et al., 2022).

2.4 The relationship between anxiety and cognitive functioning

2.4.1 Theoretical frameworks for understanding anxiety-cognition relationships

Several theoretical frameworks have been proposed to explain anxiety-cognition relationships, each emphasising different mechanisms and making different predictions about when and how anxiety symptoms affect cognitive performance.

2.4.1.1 Attentional Control Theory

The theoretical framework underlying this study is the ACT, proposed by Michael Eysenck. It offers the most comprehensive framework for understanding anxiety's impact on cognitive function. It suggests that attentional control comprises three key components: inhibition, shifting, and updating. According to ACT, anxiety disrupts cognitive functioning

by impairing these attentional control mechanisms, subsequently affecting various cognitive domains (Eysenck et al., 2007).

ACT identifies two primary attentional control systems: the top-down attentional system and the bottom-up attentional system, which interact frequently (Derakshan & Eysenck, 2009; Posner & Petersen, 1990).

This mapping of ACT's theoretical constructs onto the KABC-II subtests used in the present study provides the basis for the research hypotheses. Specifically, ACT predicts that anxiety-related attentional disruption will be most evident in subtests requiring sustained goal-directed control: Hand Movements (sequential processing, requiring inhibition of competing motor responses), Pattern Reasoning timed (planning under time pressure, taxing shifting and updating), and Atlantis/Atlantis Delayed (learning and memory, dependent on attentional encoding). Simultaneous processing (Rover) may show weaker associations as holistic pattern recognition is less reliant on sustained executive attention. Crystallised knowledge subtests fall outside ACT's primary predictions as they reflect accumulated learning rather than real-time attentional control. This theoretical mapping guided the interpretation of results in Chapter 5.

ACT proposes that anxiety disrupts the balance between the two systems by promoting stimulus-driven processes over efficient goal-driven processes. This imbalance results in an increased influence of the stimulus-driven system, coupled with a diminished influence from the goal-directed system, leading to cognitive task performance deficits (Coombes et al., 2009).

This disruption in attentional control may manifest as restlessness, heightened fatigue, difficulty concentrating, irritability, and disrupted sleep patterns, as individuals with symptoms of anxiety may struggle to regulate their attention in the presence of worry and apprehension (Rowa et al., 2017).

While Attentional Control Theory provides a robust framework for understanding anxiety-cognition relationships, it is important to acknowledge its development within Western, predominantly individualistic cultural contexts (Eysenck et al., 2007). The theory's emphasis on individual cognitive processes and performance outcomes reflects Western epistemological assumptions that may not fully capture the collectivist orientations and contextual stressors characteristic of many South African communities (Bojuwoye & Sodi, 2010). In Ubuntu-oriented cultures, anxiety may manifest not solely as individual cognitive interference but through relational disruption and communal disconnection (Mkhize, 2004). Furthermore, the chronic adversities experienced by many South African adolescents, including poverty, violence exposure, and educational inequalities, may produce anxiety presentations that diverge from the primarily threat-focused conceptualisations common in Western literature (Barbarin & Richter, 2013). Despite these contextual differences, ACT's core mechanisms of attentional capture and reduced executive control remain observable across cultural contexts (Pacheco-Unguetti et al., 2010), suggesting the theory may offer valuable insights while requiring cultural adaptation in interpretation. The present study thus employs ACT as an interpretive lens while remaining attentive to South African particularities that may nuance its application.

African scholarship offers important correctives to these Western-centric assumptions. Ubuntu philosophy, foundational to many southern African cultures, understands personhood and psychological experience as fundamentally relational and communal (Mkhize, 2004). Anxiety in this frame may manifest not as individual cognitive interference but as disruption to relational harmony and communal belonging, dimensions not captured by ACT's individual-level attentional model. Bojuwoye and Sodi (2010) further note that indigenous African epistemologies frame distress within social and spiritual contexts, potentially producing somatic and relational symptom presentations that differ markedly from the

cognitive-attentional profile ACT predicts. Empirical support for cultural variation in anxiety expression within South Africa is provided by Peter Muris et al. (2002), who found that South African children reported higher anxiety levels than Western peers, with differential symptom profiles by racial group. These findings collectively suggest that ACT's predictions require contextual calibration when applied to KwaZulu-Natal adolescents.

2.4.1.2 Processing Efficiency Theory (PET)

Eysenck and Calvo (1992) originally proposed Processing Efficiency Theory and later elaborated within attentional control frameworks. The central premise is that anxiety consumes limited cognitive resources, particularly those associated with working memory, yet does not necessarily impair observable performance outcomes unless task demands exceed compensatory capacity. Eysenck and Calvo argued that anxiety produces task-irrelevant processing in the form of worry, which competes with task-relevant cognitive operations for working memory resources. Because working memory has a limited capacity, this competition reduces processing efficiency, defined as the relationship between performance effectiveness and the cognitive effort required to achieve it. Thus, anxious individuals may achieve similar levels of accuracy compared to non-anxious individuals, but they do so less efficiently, often with slower response times or increased mental effort (Eysenck & Calvo, 1992).

Within PET, a critical distinction is made between performance effectiveness and processing efficiency. Performance effectiveness refers to the quality of task outcomes, such as accuracy or correctness, whereas processing efficiency refers to the cognitive cost of achieving that performance, typically reflected in reaction time or effort expenditure. Research has consistently shown that anxiety more reliably affects efficiency than effectiveness, particularly on tasks that heavily tax working memory. For example, studies in cognitive and sport psychology have demonstrated that anxious individuals may maintain

accuracy but exhibit slower processing speeds or increased physiological markers of effort, suggesting compensatory mechanisms at work (Mascarenhas & Smith, 2011; Wilson, 2008).

PET further proposes that anxiety triggers increased motivation to maintain performance, leading individuals to allocate additional attentional resources to offset the disruptive effects of worry. This compensatory effort may preserve observable performance in structured laboratory tasks, especially when individuals are highly motivated. However, such compensation is effortful and may not be sustainable over prolonged or highly complex tasks. When task demands exceed available cognitive capacity, both efficiency and effectiveness are likely to decline. Empirical evidence indicates that under high cognitive load conditions, such as dual-task paradigms or complex reasoning tasks, anxious individuals show measurable decrements in both speed and accuracy, suggesting limits to compensatory control (Eysenck & Calvo, 1992; Wilson, 2008).

Importantly, PET situates working memory as the core mechanism through which anxiety exerts its effects. Worry is conceptualised as a predominantly verbal, intrusive process that occupies the phonological loop component of working memory. This occupation reduces the resources available for central executive functioning, particularly in tasks requiring attentional control, updating, and inhibition. Subsequent theoretical developments, such as Attentional Control Theory, expanded on PET by specifying that anxiety impairs the efficiency of the central executive's inhibitory and shifting functions, thereby weakening top-down control over attention (Eysenck et al., 2007). This refinement strengthens PET's explanatory value by linking anxiety more directly to executive control processes.

Despite its explanatory strengths, PET has been critiqued for its primary focus on state anxiety and laboratory-based cognitive tasks. Real-world environments involve fluctuating emotional states, social evaluation, and contextual pressures that may magnify the impact of anxiety beyond efficiency alone. Some research suggests that under ecologically valid

stressors, anxiety can impair both efficiency and effectiveness, particularly when emotional regulation demands interact with cognitive load (Mascarenhas & Smith, 2011). Furthermore, PET gives comparatively less attention to trait anxiety and individual differences in cognitive control capacity. Trait-anxious individuals may demonstrate chronic attentional biases toward threat and reduced baseline executive control, which could lead to more pervasive performance impairments beyond transient efficiency costs (Eysenck & Calvo, 1992).

In sum, Processing Efficiency Theory provides a foundational framework for understanding how anxiety influences cognitive performance by distinguishing between the cost of processing and the quality of output. It highlights the central role of working memory and compensatory effort, offering a nuanced explanation for why anxious individuals may appear to perform adequately despite experiencing significant cognitive strain. However, its emphasis on efficiency over effectiveness and on state rather than trait anxiety suggests the need for integration with broader attentional and developmental models to fully capture anxiety's impact across real-world contexts.

2.4.2 Evidence of the association between anxiety symptoms and cognitive functioning

The relationship between anxiety and cognitive performance is complex, with research yielding mixed findings. This section synthesises evidence from multiple studies focusing on the impact of anxiety on various cognitive functions.

A consistent theme in the literature is that anxiety is linked to deficits in working memory and executive attention. Individuals diagnosed with an anxiety disorder performed significantly lower on tasks that involved working memory, a core component of executive functioning (Nyberg et al., 2021). Similarly, evidence indicates that anxiety affects working memory capacity and, as a result, impacts overall cognitive performance (Owens et al., 2014). A meta-analysis further confirmed that anxiety was associated with poor performance on working memory capacity tasks (Moran, 2016).

Other findings suggest that the adverse effects of anxiety extend beyond working memory. Test anxiety appears to negatively impact subtests that draw heavily on working memory, inhibition, planning, reasoning, and problem-solving (Hopko et al., 2005; Wechsler, 1997). Likewise, participants with GAD performed more poorly on tasks involving processing speed, working memory, inhibition, problem-solving, and both immediate and delayed memory compared to individuals without GAD (Butters et al., 2011).

Although the overall trend points towards cognitive disruptions, some studies highlight nuances in this association. Nyberg et al. (2021) found that anxiety impairs core executive functions, such as working memory, attention, and inhibition, but leaves higher-order executive functions intact. More recent work adds further complexity: individuals with Generalised Anxiety Disorder (GAD) exhibit slower reaction times on working memory tasks and poorer accuracy on cognitive flexibility tasks; however, there is no statistically significant association with inhibitory control. Furthermore, executive functions did not appear to be impacted in older adults with GAD (Nguyen et al., 2025). Similarly, Suddell et al. (2023) found that anxiety impacted working memory but did not impact inhibition, and overall found minimal evidence to support that anxiety leads to impairments in executive functioning.

Contradictions emerge in additional studies. One study's results demonstrated that anxiety did not impact cognitive functioning; however, when individuals in remission were excluded, the results suggested that those with a current anxiety disorder performed more poorly on visual working memory tasks (Castaneda et al., 2011). In line with this, a meta-analysis found that anxiety impacted performance efficiency but improved performance accuracy (Majeed et al., 2023). Finally, other research has concluded that high anxiety does not reliably predict working memory performance at all (Dombrowski, 2016).

Taken together, these findings illustrate that while anxiety frequently disrupts core executive functions such as working memory, attention, and inhibition, its impact on higher-order processes appears less consistent. Moreover, evidence of compensatory mechanisms suggests that in certain circumstances, anxious individuals may sacrifice efficiency to maintain or even improve accuracy.

2.5 Conclusion

The existing literature underscores a critical gap in understanding the relationship between anxiety and cognitive functioning, particularly in adolescents, which is a pivotal stage of development. A South African study has revealed alarming statistics regarding the lack of access to mental health treatment, emphasising the urgent need for awareness and effective prevention and treatment strategies (Craig et al., 2022). Moreover, several studies have highlighted the prevalence of cognitive impairments in individuals with anxiety disorders, indicating a pressing need for further investigation in this area (Castaneda et al., 2008; Nyberg et al., 2021; Owens et al., 2014).

It is important to consider the relationship between anxiety and various aspects of cognitive functioning, considering the complex context and challenges that must be navigated by adolescents living in low and middle-income countries (Fatusi & Hindin, 2010). Enhancing understanding of how anxiety influences cognition is essential to evaluate the effectiveness of treatment interventions more effectively (Fatusi & Hindin, 2010; Robinson et al., 2013).

There is a clear rationale for researching how anxiety impacts various aspects of cognitive functioning. By employing innovative methodologies and cognitive assessment techniques, this study aims to fill the existing gaps in the literature and contribute novel insights into the complex interplay between anxiety and cognitive performance within the South African context. Ultimately, the findings of this research have the potential to advance

theoretical understanding, inform clinical practice, and improve outcomes for individuals affected by anxiety disorders, thus addressing an important public health concern. The following chapter outlines the methodological approach, setting out the guiding paradigm, the study design and procedures, the sample, the instruments employed, and the statistical techniques used for the analyses.

Chapter 3

Methodology

3.1 Introduction

This chapter outlines the comprehensive methodological approach employed to examine the association between anxiety symptoms and cognitive functioning among South African adolescents. The research uses secondary analysis of Wave Three data from the Asenze Cohort Study. This data was selected because it provides valuable data on validated anxiety and cognitive measures from a large sample of adolescents in KwaZulu-Natal.

The chapter begins by presenting the underlying research paradigm and the specific research framework applied. Thereafter, it describes the broader study context from which the data were drawn, the sampling procedures, the data collection methods, the psychometric tools used to measure anxiety and cognitive functioning, their validation, the data analysis strategies, ethical considerations, and methodological limitations.

3.2 Research Design

3.2.1 Broader Asenze study design

The current study draws upon data from the Asenze study, a longitudinal, population-based research project designed to understand the development of children and adolescents in South Africa (Desmond et al., 2022). The study was designed to follow children from early childhood through adolescence, tracking multiple domains of child development over time, and collecting data on caregiver functioning, child health, social well-being, and neurodevelopment (Desmond et al., 2022). It has been jointly led by research teams from the University of KwaZulu-Natal and Columbia University's Department of Epidemiology at the Mailman School of Public Health (Desmond et al., 2022). The broader study provides the methodological framework and data set for examining the prevalence of anxiety symptoms and the anxiety-cognition association among South African adolescents.

The longitudinal project was piloted in 2004, and subsequently, data were collected across four waves to inform the development of effective, evidence-based policies and interventions. In 2008, an initial door-to-door field survey was conducted where primary caregivers provided informed consent, supplied household information, and completed the Ten Questions developmental screen for child disability in eligible children (Desmond et al., 2022). Wave One was conducted between 2008 and 2010, involving comprehensive medical, psychosocial, and developmental assessments for children, alongside social, demographic, and health information from primary caregivers (Desmond et al., 2022). Wave Two, conducted between 2010 and 2014, closely mirrored Wave One, with the addition of two cognitive achievement measures and a shortened medical history examination (Desmond et al., 2022).

The first two waves were informed primarily by the neurodevelopmental model, with a shift in the third and fourth waves to a socio-ecological model of risk and protection, incorporating a life-course perspective.

Wave Three was conducted between 2019 and 2021. Once the children had become adolescents, the study expanded to include assessments of schooling experiences, substance use, reproductive health, and family functioning and support (Desmond et al., 2022). The COVID-19 pandemic significantly affected Wave Three data collection, requiring enhanced safety protocols and modified procedures. Despite these disruptions, the wave successfully assessed the majority of eligible participants while maintaining data quality standards (Desmond et al., 2022). This data was selected for analysis because it was particularly relevant, as it allowed examination of the anxiety-cognition association during a critical period of development.

Wave Four was conducted from 2022 to 2023, approximately one to two years after Wave Three, continuing to evaluate similar aspects but focusing solely on the adolescents, without involving their primary caregivers (Desmond et al., 2022).

3.2.2 Current study research paradigm

The current study adopted a positivist paradigm, which provided a structured framework for examining the prevalence of anxiety symptoms and the associations between anxiety and cognition through objective observation and empirical evidence (Krauss, 2005; Park et al., 2020). Positivism assumes a realist ontology in which reality exists independently of human perception and can be measured through systematic investigation (Rehman & Alharthi, 2016). This philosophical position guided the adoption of a non-experimental, descriptive design using secondary data to examine measurable associations between variables. Although positivism has been critiqued for applying methods from the natural sciences to the more complex social world, it remains influential for its emphasis on generalisability and predictive validity (Blanche et al., 2006; Rehman & Alharthi, 2016).

In line with this paradigm, the study employed standardised psychometric instruments and statistical analyses to enable objective measurement of anxiety and cognition. The positivist framework, therefore, provided a coherent lens through which to investigate the prevalence of anxiety symptoms and their association with cognitive functioning among adolescents in KwaZulu-Natal.

3.2.3 Current study research design

The present study employed a cross-sectional, descriptive, quantitative design, which enabled measurement of the prevalence of anxiety symptoms and examination of associations with cognitive functioning at a single point in time. A cross-sectional approach was chosen as the study aimed to describe prevalence and associations rather than establish causality.

The design aligned with the use of secondary data drawn from Wave Three of the Asenze study, in which standardised measures of anxiety and cognition were administered. This approach provided a practical and methodologically sound means of exploring the relationship between the variables (Holton & Burnett, 2005; Taherdoost, 2022). A descriptive quantitative approach further allowed for analysis of numerical data without manipulation of variables, supporting the identification of observable patterns in a large, real-world sample (Taherdoost, 2022).

Quantitative research offers strengths such as generalisability, replicability, and efficiency, making it particularly suited to large-scale studies. However, it provides limited insight into contextual and subjective experiences, as it prioritises measurement and objectivity (Taherdoost, 2022; Velez, 2008). Despite this limitation, the quantitative design was well aligned with the present study's focus on identifying prevalence and associations between anxiety symptoms and cognitive functioning among adolescents (Taherdoost, 2022; Velez, 2008).

3.3 Sample

3.3.1 Setting

The Asenze study took place in the Valley of a Thousand Hills, an area encompassing both peri-urban and rural communities in KwaZulu Natal, South Africa (Desmond et al., 2022). The study involved five Zulu tribal areas, located approximately 45 km northwest of Durban, the largest city in the province (Desmond et al., 2022). These peri-urban areas are regions on the outskirts of urban centres, characterised by a mix of urban and rural features, including infrastructure, housing, and varying access to services (Colucci, 2017). The peri-rural areas, on the other hand, are transitional zones on the fringes of rural regions, often marked by limited access to amenities and higher levels of poverty (Colucci, 2017). This setting was critical because it provided access to adolescents living with the environmental

challenges of South Africa, thereby enabling the examination of the anxiety-cognition association within this context.

3.3.2 Population

According to Statistics South Africa (2024), the South African population exceeded 63 million by July 2024, representing a 1.33% increase between 2023 and 2024. Females made up the majority of the population, with 32 million women recorded (Statistics South Africa, 2024). KwaZulu-Natal accounted for 12.3 million of the national total (Statistics South Africa, 2024).

More specifically, in 2011, Botha's Hill had a total population of 2,190 residents within an area of 0.55 km², indicating a high population density. The area is predominantly populated by Black African individuals, with isiZulu and English being the primary spoken languages (Frith, 2011). The population of Botha's Hill is predominantly young, with many residents falling within the adolescent and young adult age ranges. There are fewer individuals in the middle-aged and older adult groups (Frith, 2011).

In addition to national and provincial data, the Asenze Cohort Study provides data on the population of Botha's Hill. Most children reside in low-income households, where individuals rely on social grants as their primary source of income (Desmond et al., 2022). The study revealed that the majority of caregivers were women. Most of them had not completed secondary education, and many were not formally employed. Many of the households also experienced challenges with food security, housing conditions, and access to basic services such as clean water and sanitation (Desmond et al., 2022).

3.3.3 Sampling and sampling method

The Asenze Study conducted a door-to-door survey across 14,425 households in the Valley of a Thousand Hills, KwaZulu-Natal, South Africa, to identify eligible participants.

From this survey, 2049 children aged four to six years who met the inclusion criteria were selected.

For the current analysis, 945 participants who completed both anxiety assessment and cognitive testing in Wave Three were included. The sample maintained the demographic characteristics of the broader Asenze cohort. This representativeness supports generalisation of findings to similar peri-urban South African adolescent populations.

3.3.4 Inclusion and exclusion criteria

Inclusion and exclusion criteria

The present study focused on adolescents aged 13 to 19 years who participated in Wave Three. Only individuals who had fully completed the Generalised Anxiety Disorder 7 (GAD-7) scale were included in the study. This was to ensure valid anxiety severity classification, as missing items cannot be reliably imputed without potentially misclarifying participants' anxiety levels (Little & Rubin, 2019; Spitzer et al., 2006). Additionally, individuals who did not fully complete a subtest on the KABC-II were excluded from the analysis. Participants who did not meet these criteria were excluded from the study. This process resulted in a final analytic sample of 945 adolescents with complete data. With regard to the inclusion of 19-year-old participants, their inclusion reflects the broader sampling framework of the Asenze Study, which follows participants longitudinally. Participants who had reached 19 years of age at the time of Wave Three assessment were therefore retained to preserve sample integrity and longitudinal continuity. Although the KABC-II provides normative data up to 18 years and 11 months, the minimal age difference between late adolescence and early adulthood, a period of relatively gradual cognitive change, was not expected to meaningfully distort group-level patterns. Analyses were conducted using age-appropriate norms where available, and interpretations were made cautiously within the

bounds of the instrument's standardisation parameters. This limitation is explicitly acknowledged in Chapter 6.

3.4 Data collection

The Asenze Study conducted a comprehensive investigation, collecting data from individuals and their primary caregivers across three waves, spanning from early childhood to adolescence. As described in 3.2.1, data were collected across four waves of the Asenze Study. Wave Three data, collected 2019–2021, form the basis of the present analysis.

3.7.1 Data cleaning and preparation

To ensure the validity and reliability of the study's findings, rigorous data cleaning procedures were implemented prior to analysis. The dataset was first examined for duplicate entries, which were removed to minimise redundancy and potential distortions in the results. The data were then systematically checked for missing values.

Particular attention was given to the GAD-7 scale, as complete responses were necessary to ensure valid classification of anxiety severity. A total of 181 participants were excluded because they had incomplete responses on one or more GAD-7 items. Similarly, participants with incomplete data on any of the six selected KABC-II subtests were excluded, as this would have compromised the comparability of cognitive performance scores across individuals.

After these exclusions, the final analytic sample comprised 945 adolescents with complete data on both the GAD-7 and the six KABC-II subtests. These procedures ensured that the data used in this study were accurate, complete, and suitable for the planned statistical analyses, thereby enhancing the trustworthiness of the findings.

3.5 Assessment tools

In quantitative research, ensuring validity, reliability, and rigour is paramount. Validity refers to the accuracy with which an instrument measures the intended construct,

while reliability reflects the extent to which a measure produces consistent results over time or across different conditions (Spitzer et al., 2006). Validated psychometric measures were translated into isiZulu and then back-translated to ensure content, construct, and face validity, as well as conceptual and linguistic equivalence between the English and isiZulu versions (Desmond et al., 2022; Foxcroft, 2011; Foxcroft & Aston, 2006). Rigour in this study was ensured through the use of validated and culturally adapted psychometric tools (Johnston, 2014). The current study focused on two assessment tools: the Generalised Anxiety Disorder Scale (GAD-7) and the Kaufman Assessment Battery for Children - Second Edition (KABC-II).

3.5.1 Psychometric tools for assessing anxiety

The GAD-7 was developed to screen for symptoms of anxiety and is commonly used in a variety of settings and populations (Spitzer et al., 2006). This seven-item instrument assesses nervousness, uncontrollable worry, excessive concern, difficulty relaxing, restlessness, irritability, and apprehension (Johnson et al., 2019).

International studies have consistently shown that GAD-7 is a reliable and valid screening tool for anxiety. It demonstrates excellent internal consistency (α ranging from .89 to .94) and strong test–retest reliability ($r \approx .84$), indicating stability over time (Garcia-Campayo et al., 2010; Lowe et al., 2008; Spitzer et al., 2006). Criterion and concurrent validity have also been established, demonstrating high correlations to other measures of anxiety (Foxcroft & Roodt, 2018; Garcia-Campayo et al., 2010). Multiple international studies, including Germany, Spain, and Canada, have confirmed a unidimensional factor structure (Hinz et al., 2023; Lowe et al., 2008). Additionally, studies demonstrate that the GAD-7 demonstrates strong diagnostic accuracy with AUC values falling between .80 and .99 and cut-off scores ranging from seven to ten, yielding reasonable specificity and sensitivity (Bowers & Zhou, 2019; Kroenke et al., 2007). Collectively, these findings

highlight the GAD-7 as a psychometrically sound instrument, particularly effective as a screening tool in diverse populations.

Narrowing the focus from global to continental contexts, studies conducted in Africa have shown validity and reliability. In Kenya, the Swahili version demonstrated good internal consistency ($\alpha = .82$), acceptable test–retest reliability (ICC = .70), and evidence of a unidimensional factor structure with convergent validity (Nyongesa et al., 2020).

In Uganda, translations into Runyoro and Luganda showed strong reliability ($\omega = .85$–.90) and moderate to strong concurrent validity with the PHQ-9 (Ziegel et al., 2025). Among Ghanaian adolescents, the GAD-7 showed adequate internal consistency ($\alpha = 0.69$) and an AUC of .70, confirming that the measure distinguished adolescents with anxiety and those without (Adjorlolo, 2020). Together, these findings suggest that the GAD-7 is generally reliable and valid across African settings.

Moving from a continental to a national lens, a growing body of research has demonstrated the GAD-7's psychometric utility across various South African populations.

In South Africa, Henn and Morgan (2019) validated the GAD-7 among African and White working adults. Minor differential item functioning (DIF) was identified on two items, meaning that individuals from different groups responded differently to specific questions despite having similar anxiety levels. However, the overall impact on scores was negligible ($\Delta R^2 < 0.035$)(Chen & Revicki, 2014; Henn & Morgan, 2019). The tool demonstrated good internal consistency and was considered fair and valid across racial groups (Henn & Morgan, 2019).

Beyond the workplace, the scale's clinical relevance has been explored among patients receiving treatment for tuberculosis in the Free State. The results found high internal consistency ($\alpha = 0.86$) and strong construct validity. Contrary to most research on the GAD-7, a two-factor structure was identified (Kigozi, 2021).

Among younger cohorts, efforts to culturally adapt the GAD-7 have further strengthened its applicability. The GAD-7 was translated and culturally adapted for use with isiXhosa-speaking adolescents. The findings indicated that the tool maintained diagnostic acceptability, achieving an acceptable AUC (0.78). A cut-off score of six or more optimised sensitivity (67%) and specificity (75%), supporting its use as a screening measure (Marlow et al., 2023).

Urban populations have also been the focus of psychometric validation. In Soweto, a large-scale study with over 6000 young women aged 18 to 28 found strong internal consistency ($\alpha = 0.84$) and confirmed construct validity and a unidimensional factor structure through confirmatory factor analysis (Hart et al., 2025). This supports the GAD-7's reliability in identifying symptoms of anxiety among South African women in a non-clinical, urban context. Similarly, Padmanabhanunni and Pretorius (2025) aimed to assess the psychometric properties and factor structure of the GAD-7 amongst first responders and confirmed a unidimensional factor structure and high internal consistency ($\alpha \geq .90$).

Further research examining the South African working population demonstrated that the GAD-7 has strong psychometric properties (Bezuidenhout, 2018). A unidimensional factor structure was confirmed through exploratory and confirmatory analysis. Excellent internal consistency ($\alpha = .92$) was reported. Additionally, convergent and discriminant validity were established. Overall, this study supported the use of the GAD-7 as a valid and reliable instrument in the non-clinical South African sample.

Regarding language of administration, the GAD 7 was administered in English or isiZulu according to participant preference. The isiZulu version used in the present study was developed through forward and backward translation procedures conducted by bilingual research assistants, with reconciliation and review by the research team. Pilot testing with 30 isiZulu speaking adolescents demonstrated acceptable internal consistency, Cronbach's alpha

equal to .81, and adequate item comprehension as assessed through cognitive interviewing. However, no large-scale published psychometric validation of this specific isiZulu version has been conducted. Although translation procedures followed established cross-cultural adaptation guidelines, full measurement equivalence cannot be assumed. This represents a limitation and highlights the need for formal validation studies of isiZulu anxiety screening instruments.

Similarly, the KABC II was administered with isiZulu instruction translation by bilingual examiners trained in culturally responsive assessment procedures. At present, no fully isiZulu normed version with locally representative South African norms is available. As noted in the South African test use literature, the application of Western normative data in culturally diverse contexts necessitates cautious interpretation and awareness of potential cultural and linguistic bias (Foxcroft & Roodt, 2013). Accordingly, findings derived from KABC II normative comparisons should be interpreted with appropriate caution.

3.5.2 Psychometric tools for assessing cognitive functioning.

The KABC-II was used to assess cognitive performance across multiple domains. This is an individually administered, norm-referenced assessment used to assess processing and cognitive abilities in children and adolescents aged three to eighteen years. This assessment is suited for individuals from various cultural and linguistic backgrounds. It was selected because it provides a comprehensive cognitive assessment that is valid, fair, and reliable in South Africa. Furthermore, it enables exploration of cognitive functioning in relation to symptoms of anxiety.

Six subtests of the KABC-II were selected to capture a range of cognitive processes and determine associations between anxiety and different aspects of cognitive functioning. Hand movements were selected to measure Sequential Processing, which refers to the capacity to encode, retain, and reproduce information in a specific serial order (Kaufman et

al., 2005). To measure Simultaneous Processing, the ability to integrate many different stimuli into a unified percept or concept, the Rover was selected (Kaufman et al., 2005). Pattern Reasoning was selected to measure the Planning scale, which assesses the ability to coherently integrate multiple pieces of information simultaneously, reflecting higher-order executive functioning skills. Pattern Reasoning is scored with a time bonus referred to as Pattern Reasoning (timed) and without a time bonus (Kaufman et al., 2005). The Atlantis and Atlantis Delayed measure the Learning scale. This involves the ability to acquire new knowledge, form associations, consolidate information, and retrieve it effectively (Kaufman et al., 2005). Knowledge subtests were not included in the present study, as they heavily draw on acquired vocabulary and cultural experiences. Instead, the focus was on process-based abilities, which provide a culturally fairer basis for assessing cognitive functioning in South African adolescents (Kaufman et al., 2005). Additionally, KABC-II norms extend until 18 years 11 months; however, 19-year-old participants were included and assessed using the highest available age norms.

The KABC-II demonstrates strong test-retest reliability across cognitive domains. The reported coefficients are r = .80 for Sequential, r = .77 for Simultaneous, r = .79 for Learning, and r = .81 for Planning, all of which fall within the acceptable to good range. This indicates that the processing scales are stable over time (Foxcroft & Roodt, 2018; Kaufman et al., 2005). In addition, the KABC-II demonstrates high internal consistency (Sequential $\alpha = .89$, Simultaneous $\alpha = .88$, Learning $\alpha = .93$, Planning $\alpha = .88$), indicating that the items within each scale consistently measure a coherent underlying construct (Foxcroft & Roodt, 2018; Kaufman et al., 2005). Construct validity has been established through Confirmatory Factor Analysis (CFA), supporting the theory-based scale structure. Convergent validity is further supported by strong correlations between KABC-II global scales and other standardised measures of intelligence, with coefficients ranging from r = .71 to.91 (Kaufman et al., 2005).

International research examined the KABC-II among a sample in the United States, which supported the measures' construct validity, meaning it assessed the intended constructs and the criterion validity, the extent to which it accurately predicts the intended outcome (Foxcroft & Roodt, 2018; McGill, 2015). Renner et al. (2023) confirmed the factorial validity of the test, which refers to how well the test's structure aligns with the theoretical model it is based on, in a clinical German sample of children aged seven to twelve. Overall, the findings suggest that the German version of the KABC-II has sound psychometric properties but should be interpreted with caution due to reduced construct validity (Renner et al., 2023).

Continentally, further validation work was conducted in Zimbabwe, where the KABC-II was piloted (Piper et al., 2022). The assessment was adapted by using culturally relevant item substitutions and additions. The construct validity Intraclass Correlation Coefficient (ICC) improved from 0.43 to 0.69, demonstrating moderate to strong internal consistency post-adaptation (Piper et al., 2022).

Nationally, the KABC-II has been validated in South Africa and is widely used. It seems to be effective in promoting fairer assessments for individuals from minority ethnic groups. Research supported the use of the KABC-II in South Africa, but suggests that adaptations may be needed to ensure cultural sensitivity (De Sousa et al., 2010; Jansen & Greenop, 2008). Additionally, the differences in scores between ethnicities are minor on the KABC-II compared to the Wechsler Intelligence Scale for Children - Fourth edition (WISC-IV) (Drozdick et al., 2018).

Mitchell et al. (2018) investigated the reliability and validity of the KABS-II in rural South Africa using Cronbach’s alpha and conducted a confirmatory factor analysis. The battery demonstrated good reliability ($\alpha = .78$) for the mental processing index and maintained a validated structure ($\chi^2 = 16.30$, $p = .432$). Notably, mean scores on the Planning Subtest were low, while the Simultaneous Subtest showed higher mean scores for the

supplementary Block Counting Subtest compared to the core Triangles subtest. It was concluded that the inclusion of translated and supplementary subtests enhanced its suitability for the KwaZulu-Natal adolescent cohort (Mitchell et al., 2018).

While the KABC-II provides a comprehensive and culturally responsive assessment of broad cognitive functioning, it is important to recognise that the battery is not specifically designed to isolate discrete executive attention processes with the precision of specialised neuropsychological measures. Attentional Control Theory proposes that anxiety primarily disrupts executive functions such as inhibition, shifting, and updating. As the KABC-II assesses these processes within broader cognitive domains rather than as discrete constructs, subtle attentional control inefficiencies associated with anxiety may not be fully captured. The instrument was nevertheless selected due to its strong psychometric properties, developmental appropriateness, and relevance for assessing functional cognitive performance within the study context.

3.6 Data handling

All data collected in this study is safeguarded and kept strictly confidential, unless there is a legal requirement to disclose specific information. Each participant was assigned a unique study number to protect their identity. The list linking participant names to their numbers is stored separately in a locked cabinet, while electronic copies are stored on a secure, password-protected computer hosted on Google Cloud. These electronic files do not include any identifiable personal information.

All records generated during the study are accessible only to authorised staff at the University of KwaZulu-Natal and the Research Ethics Committee. Data is kept securely and remains confidential throughout the duration of the study.

For the current analysis, only anonymised data was provided. Analysis was conducted using the study participant numbers and questionnaire responses, with no access to names or other personal identifiers, ensuring complete participant anonymity.

3.7 Data analysis

The data analysis was designed to address the study's research objectives systematically.

3.7.1 Descriptive Statistics

Descriptive statistics were used to summarise the characteristics of the sample and to establish the prevalence of anxiety symptoms (Pallant, 2020). GAD-7 scores were categorised using established clinical cut-offs: None (0-4); Mild (5-9); Moderate (10-14), and Severe (15-21). Frequencies and percentages were calculated to determine the distribution of participants across these categories, providing a base rate of anxiety symptom severity within the population.

Cross-tabulations were conducted to explore the prevalence of anxiety across age and gender categories to provide context for understanding anxiety symptom distribution across the population (Pallant, 2020). In addition, frequency distributions were conducted for each KABC-II subtest to establish cognitive performance patterns regardless of the level of anxiety symptoms (Pallant, 2020). Finally, cross-tabulations were used to describe the distribution of KABC-II scaled scores across the five descriptive categories (Lower Extreme, Below Average, Average, Upper Average, Upper Extreme) within each GAD-7 anxiety severity group. Frequencies and percentages for each cell were reported to provide an overview of performance patterns. The KABC-II scaled scores were grouped into five descriptive categories based on the distribution of scaled scores in relation to the normative mean and standard deviations (Kaufman et al., 2005).

3.7.2 Inferential Statistics

To examine the association between anxiety and cognitive functioning, chi-square tests of independence were conducted. This approach was appropriate as both variables were categorical: GAD-7 anxiety severity categories (none, mild, moderate, severe) and descriptive cognitive functioning classifications across six KABC-II subtests (Lower Extreme, Below Average, Average, Upper Average, and Upper Extreme)(Pallant, 2020).

For the analysis, new categorical variables were created from the original GAD-7 scores. Cases scoring in the mild range were extracted and recoded into a new variable contrasting mild anxiety with no anxiety. Similarly, cases scoring in the severe range were extracted and recoded into a variable contrasting severe anxiety with no anxiety. These variables were then cross-tabulated with cognitive performance categories, and chi-square tests of independence were conducted to examine associations. Moderate cases were excluded, as the study aimed to examine whether mild or severe anxiety was associated with cognitive outcomes relative to asymptomatic participants.

In several analyses, the assumptions of the chi-square test were not met due to low cell frequencies in the data. In such cases, the Fisher–Freeman–Halton exact test was employed, as it provides an exact probability value and is more reliable for sparse contingency tables (Pallant, 2020). To account for multiple comparisons, which increase the risk of Type I errors, the Bonferroni correction was applied to control the family-wise error rate and maintain the overall significance threshold (Pallant, 2020). Cramer's V was reported as a measure of effect size, with conventional thresholds used to interpret the magnitude of associations, to evaluate the strength of significant associations (Pallant, 2020).

3.8 Ethical considerations

3.8.1. Permissions

Ethical clearance for all phases of the Asenze Cohort Study, including any alterations, was granted by the Biomedical Research Ethics Committee (BREC Ref No: BE609/18) at the University of KwaZulu-Natal and the Institutional Review Board at Columbia University (IRB No. AAAC2559). Additionally, the study obtained approval from local authority councils and the district health committee (Desmond et al., 2022)

The secondary study was approved by the Humanities and Social Sciences Research Ethics Committee (HSSREC/00007313/2024) as a sub-study of the above-mentioned study. (Appendix 2)

3.8.2 Informed consent

Permission was obtained from both parents/caregivers (through written informed consent) and participants (through assent) before the commencement of the study. Informed consent was administered by a trained research assistant in the language of the participants' choice, either English or isiZulu.

The consent form (Appendix 4) detailed the study's objectives. During this process, participants were provided with information about the study, the assessments they would participate in, and the potential risks and benefits of participation, to enable them to make an informed decision. Participants were assured of the confidentiality of their participation and informed that they could withdraw from the study at any time.

3.8.3 Anonymity and confidentiality

During the longitudinal Asenze study, each participant and caregiver was assigned a unique study participant number upon completion of the questionnaire. This number was used throughout the study to maintain anonymity and minimise the potential risk of harm. To ensure confidentiality, names and corresponding study participant numbers were stored

separately from completed questionnaires in secure cabinets and on a password-protected computer server.

3.8.4 Respect for persons

The principle of respect for persons was upheld by ensuring that all individuals participating in the research were treated as autonomous agents (Biomedical & Research, 1978). This was achieved by providing potential participants with comprehensive information about the study, including its purpose, procedures, potential risks, and benefits. Participants were then able to make an informed decision about whether or not to join the study. Their participation was entirely voluntary, and they were free to withdraw from the study at any time without penalty or loss of benefits.

3.8.5 Beneficence

The ethical principle of beneficence was adhered to throughout the research process. Beneficence is an ethical duty of the researcher and does not only refer to avoiding harm but to actively promoting the well-being of participants (Biomedical & Research, 1978; Nora, 2013). The research design included careful consideration of the potential impacts on participants and steps taken to ensure their safety and well-being. Informed consent procedures were employed, and participants were offered support or resources if any discomfort or distress arose as a result of their participation.

3.8.6 Coercion

The principle of avoiding coercion was strictly adhered to in the research. Participants were informed clearly and explicitly that their involvement in the study was completely voluntary. They were assured that there would be no negative consequences or penalties if they chose not to participate. Additionally, efforts were made to ensure that participants did not feel pressured or obligated to join the study. This was achieved through clear

communication. By eliminating all forms of coercion, the study respected the autonomy of the participants and upheld the highest ethical standards.

3.10 Conclusion

This chapter presented a comprehensive methodological framework for identifying the prevalence of anxiety symptoms and examining the anxiety-cognition relationship among South African adolescents through secondary analysis of the Asenze Cohort Study data. The research design, sampling strategy, data collection procedures, and psychometric tools used to assess anxiety and cognitive functioning were outlined.

The study employed a large sample and validated instruments, providing a sound foundation for establishing baseline prevalence rates and for examining associations between anxiety severity and cognitive performance across multiple domains, including potential domain-specific effects predicted by ACT.

A cross-sectional, descriptive quantitative design was implemented, and rigorous statistical procedures were applied, including chi-square analyses with assumption checks and Bonferroni corrections for multiple comparisons. These methodological decisions ensured both robustness and interpretability of findings. Despite these strengths, several limitations must be acknowledged. The cross-sectional design precludes causal inference, the reliance on secondary data limits control over data collection procedures, and high rates of missing responses may restrict the generalisability of results.

Taken together, the methodology provided a rigorous and coherent approach for addressing the study's objectives, while recognising constraints that should be considered when interpreting the findings, which are described in Chapter 4.

Chapter 4

Results

4.1 Introduction

This chapter presents the findings of the analyses examining the prevalence of mild and severe anxiety among adolescents living in KwaZulu-Natal, and exploring whether these symptoms are associated with reduced cognitive functioning. The results are organised to systematically address the four research objectives, progressing from sample characteristics through descriptive patterns to inferential analyses. All analyses were conducted using IBM SPSS Statistics 29.0.

Descriptive statistics were used to establish sample characteristics, the prevalence of mild and severe anxiety was determined by the Generalised Anxiety Disorder 7 (GAD-7) scale, and the distribution of cognitive performance across the Kaufman Assessment Battery for Children Second Edition (KABC-II) subtests (Pallant, 2020). A crosstabulation analysis was conducted to examine the distribution of anxiety symptoms across gender and age (Pallant, 2020). Additionally, a descriptive frequency analysis was conducted to describe how participants scored within the five standard descriptive categories for each KABC-II subtest.

Inferential analyses then examined whether anxiety symptoms were associated with reduced cognitive functioning. A separate chi-squared test of independence was performed for mild and severe symptoms (Pallant, 2020). Effect sizes were reported using Cramer's V to indicate the strength of associations. When assumptions of the chi-square test were violated due to low expected cell counts, Fisher–Freeman–Halton exact tests were used to provide more reliable probability estimates (Pallant, 2020). To control for Type I error across multiple comparisons, a Bonferroni-adjusted significance threshold of $\alpha = .0083$ was applied.

The mild and severe anxiety analyses are treated as two separate families of tests, each comprising six KABC-II subtest comparisons. Accordingly, the Bonferroni-adjusted alpha is $\alpha = .05 \div 6 = .0083$ for each family. This threshold of $\alpha = .0083$ is applied consistently throughout all results reported in this chapter. Any prior reference to $\alpha = .0042$ should be corrected to $\alpha = .0083$.

4.2 Characteristics of the Wave Three

In Wave Three, 70.2% (1,126) of the children and 77% (980) of the caregivers who completed Wave Two also completed the Wave Three assessments (Desmond et al., 2022). The current study excluded participants who had not completed the GAD-7 (n = 181), forming the final analytic sample (n = 945).

Table 1:

Retention of children and caregivers across study phases

Study Phase	Children (% of previous phase)	Caregivers (% of previous phase)
Eligible	2049 (100)	1893 (100)
Consented	1787 (87.2)	1636 (86.4)
Wave One Completed	1581 (88.5)	1437 (87.8)
Wave Two Completed	1409 (89.5)	1273 (88.6)
Wave Three Completed	1126 (70.2)	980 (77)

4.2.1 Demographics of the sample

A total of 945 adolescents were included in the study, with a nearly equal distribution by gender: 48.7% (n = 460) were male, and 51.3% (n = 485) were female. Participants' ages ranged from 13 to 19 years. Age distribution is reported in three bands in Table 2; the 15 to 16-year band contains the largest proportion.

Table 2:

Gender and age distribution of the sample

Characteristics	Group	% (n)
Gender	Male	48.7 (460)
	Female	51.3 (485)
Grouped age	13-14 years	5.2 (49)
	15-16 years	73.8 (697)
	17-19 years	21.1 (199)

4.3 Prevalence of anxiety symptoms

Table 3 presents data for cases with both complete responses and those with a single missing response from the GAD-7 questionnaire. However, for this analysis, only fully completed questionnaires were considered. This decision was made to ensure consistency and to maintain the reliability of the findings. A total of 181 (16.07%) participants were excluded due to incomplete data on one or more GAD-7 items.

Percentages were calculated using valid cases. Participants were classified into four categories based on established cut-offs: None (scores 0 to 4), 50.7% (n = 479), indicating that most participants did not report anxiety symptoms; Mild (5 to 9), 32.8% (n = 310); Moderate (10 to 14), 12.1% (n = 114); and Severe (15 to 21), 4.4% (n = 42).

Table 3:

Disaggregated prevalence of anxiety symptom severity by GAD-7 completion status

	Completed GAD-7 cases
	% (n)
None	50.7 (479)
Mild anxiety symptoms	32.8 (310)
Moderate anxiety symptoms	12.1 (114)
Severe anxiety symptoms	4.4 (42)

4.3.1 Prevalence of anxiety symptoms across gender

To further explore prevalence patterns within the cohort, the distribution of anxiety symptom severity was examined across gender. Descriptively, symptoms of anxiety appeared to be experienced at similar rates by males and females, with comparable proportions across all severity categories, with 33% of females and 32.6% of males reporting mild symptoms. In comparison, 5.4% of females and 3.5% of males reported severe symptoms.

A chi-square test of independence confirmed that there was no significant association between gender and anxiety levels, $\chi^2(3, N = 945) = 2.18$, $p = .536$. These results suggest that in this cohort, the experience of anxiety symptoms was relatively evenly distributed across genders, with no evidence of gender-related differences in severity.

Table 4:

Prevalence of anxiety symptom severity across gender

	Female	Male
	Valid % (n)	Valid % (n)
None	50.1 (243)	51.5 (236)
Mild anxiety symptoms	33 (160)	32.6 (150)
Moderate anxiety symptoms	11.5 (56)	12.6 (58)
Severe anxiety symptoms	5.4 (26)	3.5 (16)

4.3.2 Prevalence of anxiety symptoms across age

Anxiety prevalence was also examined by age group to identify possible developmental differences in symptom severity. Descriptive results indicated that overall distributions were broadly similar across groups; however, a higher proportion of participants aged 13-14 reported moderate symptoms (20.4%) compared with those aged 15-16 (11.5%) and 17-19 (12.1%).

A chi-square test of independence indicated no significant association between age group and GAD-7 anxiety classification, $\chi^2(6, N = 945) = 5.96$, $p = .427$. This suggests that, despite the slightly elevated rate of moderate symptoms among the youngest adolescents, overall patterns of anxiety symptom severity did not differ significantly by age.

Table 5:

Prevalence of anxiety symptom severity across age

	13-14	15-16	17-19
	Valid % (n)	Valid % (n)	Valid % (n)
None	42.9 (21)	51.8 (361)	48.7 (97)
Mild anxiety symptoms	30.6 (15)	32.9 (229)	33.2 (66)
Moderate anxiety symptoms	20.4 (10)	11.5 (80)	12.1 (24)
Severe anxiety symptoms	6.1 (3)	3.9 (27)	6.0 (12)

4.4 Distribution of scaled scores in KABC-II subtests

To understand how participants performed across the KABC-II subtests, a descriptive frequency analysis was conducted to explore the distribution of scaled score categories for each subtest among those who fully completed the GAD-7. The performance distribution across the KABC-II subtests was negatively skewed with a high concentration of participants falling in the Lower Extreme ranges, contradicting standardised norms.

For the Atlantis subtest, which measures learning ability and memory, 5% (n = 47) fell in the lower extreme range. The majority of participants, 52.8% (n = 499), fell within the below-average range, followed by 38.8% (n = 367) in the average range. Only 3% (n = 28) scored in the upper average range, and 0.2% (n = 2) in the upper extreme range. These results highlight that most participants fell in the below-average range, with very few participants falling in the extreme ranges.

A similar trend was observed in the Atlantis Delayed subtest, which evaluates delayed memory and learning ability, where 6% (n = 57) scored in the lower extreme. The majority fell within the below-average range, 43.8% (n = 141), and the average range, 47.3% (n =

447), followed by 2.5% (n = 24) falling in the upper average range, and none falling in the upper extreme range.

On the Pattern Reasoning (timed) subtest, which measures planning ability, 14.2% (n = 134) of participants fell within the lower extreme, while 62.8% (n = 593) were classified in the below-average range. 22.4% (n = 212) scored in the average range, and only a tiny proportion of participants, 0.4% (n = 4), fell in the upper average range, with none falling in the upper extreme.

In contrast, Pattern Reasoning (without time-point bonus), which also measures planning ability without time pressure, revealed that 5.7% (n = 54) fell into the lower extreme. 53.7% (n = 507) were in the below-average range, and 25% (n = 236) were in the average range. Notably, 6% (n = 57) of participants scored in the upper average category, and 2.9% (n = 27) in the upper extreme range.

For the Hand Movements subtest, which assesses motor functioning and non-verbal index, 13.9% (n = 131) fell in the lower extreme. The most significant percentage of scores, 49% (n = 463), fell within the below-average range, followed closely by 36.4% (n = 344) in the average range. Additionally, 0.5% (n = 5) scored in the upper average, and none fell in the upper extreme.

Lastly, the Rover subtest, which measures simultaneous processing, showed 20.1% (n = 190) in the lower extreme, followed by 39.3% (n = 371) in the below-average range. The same proportion, 39.3% (n = 371), fell in the average range. A small proportion of 1.1% (n = 10) scored in the upper average range, and no participants fell within the upper extreme.

Table 6:

Distribution of descriptive categories across KABC-II subtests of individuals who completed the GAD-7

Descriptive Category	Atlantis	Atlantis Delayed	Pattern Reasoning (timed)	Pattern Reasoning (untimed)	Hand Movements	Rover
	% (n)	% (n)	% (n)	% (n)	% (n)	% (n)
Lower Extreme	5 (47)	6 (57)	14.2 (134)	5.7 (54)	13.9 (131)	20.1 (190)
Below Average	52.8 (499)	43.8 (141)	62.8 (593)	53.7 (507)	49 (463)	39.3 (371)
Average	38.8 (367)	47.3 (447)	22.4 (212)	25 (236)	36.4 (344)	39.3 (371)
Upper Average	3 (28)	2.5 (24)	0.4 (4)	6 (57)	0.5 (5)	1.1 (10)
Upper Extreme	0.2 (2)	0	0	2.9 (27)	0	0
Missing responses	0.2 (2)	0.3 (3)	0.2 (2)	6.8 (64)	0.2 (2)	0.3 (3)

Note: Descriptive ranges are based on standard KABC-II scaled score classifications.

4.5 The relationship between anxiety symptoms and cognitive performance

4.5.1 Descriptive performance patterns by anxiety group

To explore the relationship between anxiety symptom severity and cognitive performance, cross-tabulation analyses examined the distribution of KABC-II scaled scores across the five descriptive categories for each subtest. The standardised residuals were used to identify any unexpected distribution patterns (Pallant, 2020).

Overall, the majority of participants in both mild and severe anxiety groups fell within the Below Average and Average categories across subtests. This is consistent with the negatively skewed performance patterns observed in the sample before including anxiety

symptoms. Only small proportions of individuals scored in the Upper Average and Upper Extreme categories.

The Pattern Reasoning timed showed a significant standardised residual, indicating that more individuals with severe symptoms of anxiety scored in the Upper Average category than expected under the null hypothesis of no statistically significant association (Unit, 2020).

The other subtests did not show notable deviations between anxiety groups. Atlantis and Atlantis Delayed assessed learning and memory, Hand Movements measured sequential processing, and Rover assessed simultaneous processing. The standardised residuals across these tasks were small in magnitude, which suggests that performance patterns followed as expected and did not differ meaningfully between mild and severe anxiety groups (Unit, 2020)

These analyses highlight that while overall cognitive performance in the sample tended to cluster below the normative mean, the Pattern Reasoning (timed) subtest showed an isolated instance where severe anxiety was associated with unexpectedly higher performance outcomes.

Table 7:

Cross-tabulation of KABC-II subtest performance categories by mild and severe anxiety symptoms with standardised residuals

Subtest	Category	Mild	Residuals	Severe	Residuals
Atlantis	Lower extreme	9.7 (30)	0.2	7.1 (3)	-.4
	Below average	49 (152)	0	40.5 (17)	-.7
	Average	38.1 (118)	-0.1	45.2 (19)	.6
	Upper average	8.7 (9)	-0.1	7.1 (3)	1.5
	Upper extreme	1.6 (1)	-0.5	0	-
Atlantis Delayed	Lower extreme	12.6 (39)	-0.1	14.3 (6)	0.2
	Below average	38.1 (118)	0	28.6 (12)	-0.9
	Average	46.5 (144)	0	54.8 (23)	0.7
	Upper average	2.9 (9)	0.1	2.4 (1)	-0.1
	Upper extreme	0	-	0	-
Pattern Reasoning (Timed)	Lower extreme	42.3 (131)	-0.9	40.5 (17)	-0.6
	Below average	34.2 (106)	1.1	23.8 (10)	-0.5
	Average	23.2 (72)	0	31.0 (13)	0.9
	Upper average	0.3 (1)	0.2	4.8 (2)	3.6
	Upper extreme	0	-	0	-
Pattern Reasoning (Untimed)	Lower extreme	10.8 (31)	-1.5	20.6 (7)	0.6
	Below average	52.4 (151)	0.8	38.2 (13)	-0.7
	Average	27.1 (78)	-0.1	26.5 (9)	-0.1
	Upper average	5.9 (17)	-0.2	11.8 (4)	1.4

	Upper extreme	3.8 (11)	-0.2	2.9 (1)	-0.3
Hand Movements	Lower extreme	22.3 (69)	0.5	14.3 (6)	-0.8
	Below average	42.9 (133)	0.1	45.2 (19)	0.3
	Average	34.5 (107)	-0.3	40.5 (17)	0.4
	Upper average	0.3 (1)	-0.7	0	-0.6
	Upper extreme	0	-	0	-
Rover	Lower extreme	27.7 (86)	-0.2	21.4 (9)	-0.8
	Below average	31.6 (98)	0.4	31 (13)	0.2
	Average	40 (124)	0	47.6 (20)	0.7
	Upper average	0.6 (2)	-1.0	0	-0.8
	Upper extreme	0	-	0	0

4.5.2 Chi-Square tests of independence

4.5.2.1 Chi-square tests of independence between mild anxiety symptoms and categorical cognitive performance levels on six KABC-II subtests

A series of Chi-square tests of independence was conducted to examine whether there was a significant association between mild anxiety symptoms (compared to no anxiety symptoms) and cognitive performance across six KABC-II subtests. Cognitive performance was categorised using KABC-II descriptive scaled score classifications. The results indicated that there were no significant associations between anxiety symptom level and performance on any of the subtests. All the effect sizes were small, $V<0.10$, suggesting that they have negligible practical significance (Pallant, 2020).

For the Atlantis subtest, the association was not significant, $\chi^2(4, N = 788) = 0.482$, $p = .975$, $V = .025$. Similarly, there were no significant associations for Atlantis Delayed, $\chi^2(3, N = 787) = 0.029$, $p = .999$, $V = .006$; Pattern Reasoning (Timed), $\chi^2(3, N = 788) = 3.187$, $p =$

.307[a], V = .064; Pattern Reasoning (Untimed), $\chi^2(4, N = 735) = 4.901$, p = .298, V = .082; Hand Movements, $\chi^2(3, N = 788) = 1.324$, p = .774[a], V = .041; and Rover, $\chi^2(3, N = 788) = 1.929$, p = .587, V = .049.

These results suggest that the presence of mild anxiety symptoms was not significantly associated with differences in cognitive performance classification across the six KABC-II subtests.

Table 8:

Chi-square analysis of the association between mild anxiety symptoms and cognitive performance across KABC-II subtests

Subtest	χ^2 (df)	*p*	Cramer's V
Atlantis	.482 (4)	0.975	.025
Atlantis Delayed	0.029 (3)	0.999	.006
Pattern Reasoning (Timed)	3.187 (3)	0.307[a]	.064
Pattern Reasoning (Untimed)	4.901 (4)	0.298	.082
Hand Movements	1.324 (3)	0.774[a]	.041
Rover	1.929 (3)	0.587	.049

Note. [a]Fisher-Freeman-Halton Exact test values were reported due to the assumption that more than 20% of the expected cell count is less than 5.

4.5.2.2 Chi-square tests of independence between severe anxiety symptoms and categorical cognitive performance levels on six KABC-II subtests

This section presents the results of Chi-square tests of independence conducted to examine whether there were significant associations between severe anxiety symptoms and cognitive performance across six KABC-II subtests. Descriptive patterns and test results are reported below.

A series of Chi-square tests of independence was conducted to determine whether severe anxiety symptoms were associated with differences in cognitive performance classification across six KABC-II subtests. For most subtests, there was no statistically significant association between severe anxiety symptoms and performance classification. Specifically, Atlantis, $\chi^2(4, N = 520) = 3.863$, $p = .392^a$, $V = .086$; Atlantis Delayed, $\chi^2(3, N = 519) = 1.549$, $p = .671$, $V = .055$; Pattern Reasoning (Untimed), $\chi^2(4, N = 481) = 3.246$, $p = .517$, $V = .082$; Hand Movements, $\chi^2(3, N = 520) = 1.299$, $p = .760^a$, $V = .054$; and Rover, $\chi^2(3, N = 520) = 2.045$, $p = .563$, $V = .063$, were all non-significant.

A statistically significant association was found for the Pattern Reasoning (Timed) subtest, $\chi^2(3, N = 520) = 15.528$, $p < .05$. However, as the chi-squared assumptions were violated, a post hoc Fisher-Freeman-Halton Exact Test was conducted. The association between severe anxiety and performance on the Pattern Reasoning (timed) subtest was statistically significant ($p = .024^a$). Cramer's V was used to measure the effect size analysis, which indicated a small effect size ($V = 0.173$). After applying a Bonferroni correction (adjusted $\alpha = 0.0083$), none of the subtests remained significant.

These findings suggest that, overall, severe anxiety symptoms were not significantly associated with differences in cognitive performance classification across the KABC-II subtests.

Table 9:

Chi-square test results examining the association between severe anxiety symptoms and cognitive performance across KABC-II subtests

Subtest	χ^2 (df)	*p*	Cramer's V
Atlantis	3.863 (4)	.392[a]	.086
Atlantis Delayed	1.549 (3)	.671	.055
Pattern Reasoning (Timed)	15.528 (3)	.024[a]	.173
Pattern Reasoning (Untimed)	3.246 (4)	.517	.082
Hand Movements	1.299 (3)	.760[a]	.054
Rover	2.045 (3)	.563	.063

Note. [a]Fisher-Freeman-Halton Exact test values were reported due to the assumption that more than 20% of the expected cell count is less than 5.

4.6 Conclusion

This chapter used descriptive analysis to provide information on the prevalence of anxiety symptoms, exploring both gender and anxiety prevalence. It then used a cross-tabulation to examine the cognitive distribution. Inferential statistics were then employed to examine the association between anxiety and cognition. The results provide the empirical basis for the discussion that follows. Chapter 5 discusses and interprets the findings in relation to the theoretical framework and existing literature, and considers their implications for understanding anxiety and cognitive performance in this context.

Chapter 5

Discussion

5.1 Introduction

This chapter presents the findings of the current study, which aimed to estimate the prevalence of mild and severe anxiety symptoms and explore the relationship between anxiety symptoms and cognitive performance among a cohort of South African adolescents aged 13 to 19 years living in peri-urban KwaZulu-Natal. The prevalence estimates are summarised, and the associations between performance on the Kaufman Assessment Battery for Children Second Edition (KABC-II) subtests and anxiety levels measured by the Generalised Anxiety Disorder 7-item scale (GAD-7) are interpreted through an Attentional Control Theory (ACT) framework and located within existing literature.

5.2 Prevalence of anxiety symptoms

The findings of the present study revealed that nearly half of the sample reported some level of anxiety symptoms, with one-third of the sample experiencing mild symptoms, one-eighth reporting moderate symptoms, and a small portion falling within the severe range. Similarly, a study conducted in the Western Cape, South Africa, revealed that more than one in five adolescents reported experiencing symptoms of anxiety that were potentially indicative of a diagnosis while a study examining urban informal settlements in Durban, South Africa showed that one-fifth of both women and men reported moderate to severe symptoms of anxiety, which aligns closely with the current findings (Mkhize et al., 2024; Mkhwanazi & Gibbs, 2021). These findings, along with the current study, are consistent with previous national research highlighting the high prevalence of anxiety disorders (Herman et al., 2009). This suggests that anxiety remains a prevalent mental health disorder in the South African context. Notably, adolescents continue to experience symptoms of anxiety despite expanded mental health services and greater access to information compared to previous

years. The ongoing prevalence of mental health concerns among adolescents and young adults highlights the importance of evaluating how effectively current health information and interventions address their needs, examining barriers to access, and developing targeted solutions, particularly for those in low- and middle-income settings. Beyond understanding the prevalence, it is important to consider the factors influencing anxiety among adolescents. The high burden of anxiety observed in the current sample may be influenced by multiple social determinants of mental health prevalent in low- and middle-income countries, such as poverty, food insecurity, exposure to community violence, and limited access to quality healthcare and psychosocial services (Kim & Kim, 2023; Lund et al., 2010). These contextual stressors likely increase both the vulnerability to and persistence of anxiety symptoms among adolescents in South Africa (Lund et al., 2010). Moreover, the high prevalence of moderate to severe anxiety among peri-urban adolescents is likely to have extensive consequences. These symptoms may impact academic progression, increasing the risks of repetition and school dropout, and, in turn, constraining later employability (de Lijster et al., 2018). Furthermore, these symptoms interfere with daily functioning and quality of life (Dickson et al., 2024). Anxiety is also associated with elevated risk of self-harm and suicidality, particularly when it co-occurs with depression, exposure to violence, or other stressors. These pathways make this population especially vulnerable to severe and far-reaching consequences (de Lijster et al., 2018).

The number of adolescents experiencing severe anxiety symptoms closely aligns with international data from Steinsbekk et al. (2022), who reported a 4.5% prevalence of GAD at age 14 in a Norwegian longitudinal sample. In line with this, the worldwide prevalence of anxiety disorders in children and adolescents was found to be 6,5% (Polanczyk et al., 2015).

The current study’s results highlight and complement previous research suggesting that adolescents appear to be exceptionally vulnerable to experiencing symptoms of anxiety

(Remschmidt, 2013; Stringer, 1994). Furthermore, the results highlight the vulnerability of adolescents residing in South Africa who face many socio-economic challenges that predispose individuals and perpetuate symptoms of anxiety, compounding the overall adverse outcomes (Flisher et al., 2012; Jensen et al., 2017; Ward et al., 2012).

These results suggest that while mild to moderate symptoms of anxiety appeared to be elevated in this population, severe symptoms of anxiety are consistent with rates across contexts. This pattern suggests the need for accessible intervention, mainly to prevent the development of severe anxiety symptoms, which may be magnified in resource-constrained contexts (de Lijster et al., 2018; Dickson et al., 2024; Mkhize et al., 2024).

Notably, under-reporting in this context is a key concept to consider, with several factors potentially contributing to this. Foremost, the assessment tools may contribute to underreporting. Although the GAD-7 has demonstrated utility in South Africa, its items prioritise cognitive and affective features while many adolescents in isiZulu, isiXhosa, Sesotho and Setswana speaking communities express anxiety somatically. This results in a content mismatch between what the instrument asks about and how distress is commonly expressed locally, which the scale may not fully capture (Kigozi, 2021). This highlights how the experience of anxiety differs between cultures, which can significantly impact reporting. Individuals may unintentionally underreport due to their symptoms presenting more somatically than in line with the Western criteria (Hinton & Patel, 2017). This may understate the prevalence at standard cut-offs and produce apparent group differences that reflect differences in expression rather than severity of anxiety. Additionally, the fear of stigma is salient in many cultures, including collectivist settings such as the current study population. Open discussions of internalising disorders may be discouraged in certain cultures, which could lead to individuals not identifying their symptoms as problematic and not seeking treatment, which could have adverse knock-on effects (Abdullah & Brown, 2011;

Monnapula-Mazabane & Petersen, 2022; Sodi et al., 2022). This suggests the need for a qualitative approach to be used in tandem with the screening tool to elicit somatic information and explore answers in greater depth, thereby creating a more comprehensive picture of the prevalence.

Another compounding factor is the effects of the allostatic load. This refers to how prolonged stress can blunt emotional awareness, reducing the capacity to identify and label internal states. In chronically stressful environments, anxiety may even be perceived as a normative part of daily life rather than an abnormality. This normalisation process can contribute to under-reporting, as individuals may not recognise their experiences as symptoms of anxiety requiring disclosure (Edge et al., 2009).

Additionally, adolescents may minimise their feelings due to limited emotional awareness, which prevents them from recognising and labelling their internal states. This is known as alexithymia and can develop from inconsistent caregiving, trauma, or neglect, which are standard features of peri-urban areas (Taylor et al., 1999). To combat under-reporting, there is a need for psychoeducation on somatic symptoms of mental health disorders, mental health literacy programs, and qualitative interviewing in future research to provide more insight and understanding into the unique experiences of the isiZulu adolescents (Jorm, 2000).

5.3 The relationship between gender and anxiety

Contrary to previous research, the current study found that male and female adolescents reported similar levels of anxiety symptoms, suggesting similar prevalence between gender groups. This notable finding contrasts with a substantial body of literature, which suggests that females are at a higher risk of experiencing symptoms of anxiety and developing anxiety disorders compared to males (Altemus, 2006; Herman et al., 2009; Mkhize et al., 2024; Narmandakh et al., 2021; Polanczyk et al., 2015). Supporting this

pattern, another South African study reported comparable rates of anxiety and depression among male and female adolescents (Tadi et al., 2022). Global research generally suggests that women experience higher levels of anxiety symptoms due to hormonal influences, gender responsibilities and the fact that the environmental stress placed on women tends to evoke these symptoms (Mkhize et al., 2024).

The lack of a significant gender difference in both studies may reflect the influence of shared contextual stressors. Specifically in peri-urban communities in KwaZulu-Natal, adolescents of all genders may face similar exposure to chronic psychosocial stressors such as poverty, food insecurity, family instability, exposure to violence, and limited access to mental health care (Lund et al., 2010; Mkhwanazi & Gibbs, 2021; Patel et al., 2024). Significantly, these structural stressors may increase anxiety symptom levels among males to a point where the gender gap is reduced (Lund et al., 2010). These shared environmental hardships may mitigate the typical gender disparities observed in other contexts, as both males and females experience comparable levels of emotional distress under sustained adversity.

5.4 The relationship between age and anxiety

In contrast to previous studies in this population, there was no evidence of an association between age and anxiety in this cohort of adolescents living in KwaZulu-Natal. Previous research suggests that older adolescents are more likely to experience heightened anxiety symptoms due to the accumulation of age-specific stressors such as academic pressure, identity development, role responsibility and future uncertainty (Brenes, 2006; Costello et al., 2003; Essau et al., 2000; Mkhize et al., 2024).

Widespread socioeconomic and environmental stressors in the South African context may explain the absence of age-based differences in the current sample (Das-Munshi et al., 2016; Lund et al., 2010). Adolescents in peri-urban communities may face consistent and

overlapping forms of adversity from a young age. In such contexts, a flattening effect may occur whereby adolescents across age groups display similarly elevated anxiety symptoms due to shared life stressors (Wadsworth, 2015). In this cohort, younger and older adolescents appeared to encounter a comparable set of stressors, which contrasts with the typical pattern in which stress exposure increases with age. This relative uniformity of adversity may nullify expected developmental differences and help explain the absence of an age–anxiety association, suggesting that cumulative risk across the age range, rather than chronological age, is the more salient correlate of anxiety (Evans et al., 2013). Thus, the lack of a significant relationship between age and anxiety in this study may reflect a levelling effect of a high-stress environment, where psychosocial risk factors are not limited to specific developmental stages but rather are experienced broadly and consistently throughout adolescence.

5.5 Cognitive performance patterns within this study

The distribution of scaled scores across the six KABC-II subtests in the current sample deviated notably from the expected normal distribution usually seen in standardised cognitive assessments (Furr, 2021). Instead of a bell-shaped curve, with the highest proportion centred around the Average category, the distribution displayed a higher concentration of scores in the Lower Extreme and Below-Average categories. The overall distribution of scores across all subtests was negatively skewed. This indicates that the sample performed significantly lower than the typical population and suggests cognitive abilities within this group may generally fall below the expected norm (Furr, 2021).

Several interrelated influences likely shape these cognitive patterns. The cumulative burden of environmental stressors, neurocognitive vulnerabilities, mental health symptoms, family and school contexts, material deprivation, and health-related constraints may interact to compound their effects and impair cognitive functioning. Taken together, the findings

suggest a synergistic process in which multiple co-occurring factors act in concert to depress performance rather than operating as isolated, additive influences. Neurodevelopmental trajectories are negatively impacted by socioeconomic influences such as poverty, substance abuse, chronic stress, early life adversities and poor prenatal conditions such as maternal nutrition, stress and low birth weight (Calling et al., 2019; Fjortoft et al., 2024; Goldenberg et al., 2008; Graham et al., 2022; Lupien et al., 2009; Monk et al., 2012; Ranjbaran et al., 2018).

Furthermore, structural inequalities continue to perpetuate unequal access to quality education, enriching experiences, and resources that support cognitive development. Low socioeconomic status is frequently associated with poorer cognitive functioning (Das-Munshi et al., 2016; Lund et al., 2010; Mutola et al., 2023). Persistent poverty and related adversities such as trauma and neglect are associated with alterations in neurobiological development and stress-response systems that may impair cognitive functioning. In this study context, these environmental exposures plausibly contributed to the lower cognitive performance observed (Koshy et al., 2024; McEwen, 2007; McLaughlin et al., 2019; Teicher & Samson, 2016).

Evidence from developmental science indicates that early nurturing stimulation supports neural building for attention, language, memory and self-regulation, which in turn underpins later learning and socio-emotional adaptation, whereas its absence is associated with lasting disadvantages in these domains (Richter et al., 2017). In settings where caregivers contend with poverty, unemployment and food insecurity, day-to-day survival often takes precedence over cognitively enriching interactions and play, limiting the frequency and quality of interactions, reading and exploratory play that drive early synaptic tuning and executive control, further impeding developmental progress (Richter et al., 2017).

Chronic malnutrition and illness during the first 1000 days of a child's life can restrict brain growth and compromise myelination, with later lasting effects on processing efficiency

and learning capacity across childhood and adolescence (Walker et al., 2007). Access to books, toys, safe play spaces, quality childcare, and early learning opportunities narrows the scaffolding children receive to practise working memory, language, and problem-solving, which can depress performance on tasks that rely on these capacities in later years (Black et al., 2017). HIV and AIDS likely contribute additional neurocognitive risk in this cohort, as HIV and nonadherence to medication are linked to lower cognitive functioning (Kagee et al., 2011; Lankowski et al., 2014; Uwishema et al., 2022)

The Atlantis Delayed subtest, which measures learning and memory, was the only area in which the majority of participants scored in the Average range. In standardised cognitive assessments, approximately 68% of individuals are typically expected to fall within this range (Furr, 2021). Atlantis Delayed was the only subtest where the score distribution approximated age norms. This task relies less on language and schooling demands, it has minimal reliance on processing speed, and provides scaffolding by repeated learning trials, all of which can buffer performance against environmental constraints that depress other subtests. The result suggests relatively preserved paired-associate learning and short-term retention in this cohort. At the same time, tasks with greater language, speed, or school-dependent demands appear more sensitive to contextual factors. However, in the present sample, even this comparatively stronger performance remained well below the normative expectation.

Across all other subtests, the most significant proportion of participants fell in the Below Average range, with percentages far exceeding the expected 13.6%. These values were closer to what would be expected for the Average range, highlighting the negative shift in the distribution of scores.

The Upper Average range was minimally represented across subtests, more closely aligning with what is expected for the Upper Extreme range in a normative population. The

Pattern Reasoning (untimed) was the only subtest where the proportion of individuals in the Upper Extreme range matched the expected distribution.

When comparing the Pattern Reasoning (timed) and Pattern Reasoning (untimed) conditions, discrepancies emerged. The timed version had a much higher concentration of individuals who fell in the Below Average range. In contrast, no participants fell in the Upper Extreme and very few in the Upper Average range. These results suggest that time constraints amplified performance difficulties, further suppressing higher-level outcomes. With the sample's cognitive performance profile established, the central question of this study can now be addressed: whether anxiety symptom severity is associated with differences in cognitive functioning across the KABC-II subtests.

5.6 The association between symptoms of anxiety and cognitive performance

Attentional Control Theory (ACT) provided the guiding theoretical lens for the present study. ACT predicts that elevated anxiety will disrupt the balance between goal-directed (top-down) and stimulus-driven (bottom-up) attentional control, with the greatest impairment expected on tasks requiring sustained executive attention, inhibition, and working memory under cognitive load (Eysenck et al., 2007). The following sections evaluate each finding against these ACT-derived predictions, considering both where the data converge with and diverge from theoretical expectations, and what those divergences reveal about the applicability of ACT in high-adversity, non-Western adolescent contexts.

Attentional Control Theory (ACT) provides the central interpretive lens for the findings reported in this chapter. ACT predicts that elevated anxiety disrupts the balance between goal-directed (top-down) attentional control and stimulus-driven (bottom-up) processing, producing the greatest performance decrements on tasks requiring sustained executive attention, inhibition, and working memory under cognitive load (Eysenck et al., 2007). Each finding below is evaluated against these ACT-derived predictions, with

particular attention to where the data converge with and diverge from theoretical expectations, and what those divergences reveal about the applicability of ACT in a high-adversity, non-Western adolescent context.

The present study aimed to investigate whether symptoms of mild anxiety and severe anxiety were associated with reduced cognitive functioning. ACT predicts that symptoms of anxiety will impair cognitive performance, particularly on tasks that require executive attention processes. The absence of a significant association between the GAD-7 results and KABC-II subtests in terms of anxiety and cognition challenges the application of ACT to this population, suggesting fundamental differences in how anxiety operates under conditions of chronic adversities. Mild symptoms of anxiety, measured by the GAD-7, were not associated with reduced cognitive functioning demonstrated through performance on six subtests of the KABC-II. This finding suggests that mild anxiety symptoms may not substantially impact cognitive functioning. Similarly, symptoms of severe anxiety were not associated with reduced cognitive functioning for five of the KABC-II subtests. Several mechanisms may account for these unexpected findings. Chronic exposure to stress is hypothesised to foster adaptive effects called stress inoculation, which enables individuals to develop resilience and cope with subsequent challenges (Rutter, 2012). Therefore, anxiety may not interfere with their cognitive functioning as it does in populations who do not experience chronic stress. Similarly, a concept referred to as the "steeling effect" may occur. This is where individuals experiencing persistent adversity develop coping mechanisms and cognitive resilience, which may act as a buffer against the impact of anxiety on cognitive performance (Luthar, 2015). At a neurobiological level, a new baseline of activity may be created due to repeated stress or the allostatic load. The new baseline of activity raises the threshold for stress responses to manifest (McEwen, 1998).

A large proportion of individuals observed in the below-average performance across anxiety symptom groups suggests that environmental factors may restrict cognitive functioning in such a way that anxiety symptoms cannot produce further reductions in cognitive functioning. This aligns with Evans (2006), who highlights that chronic stress can create a lowered baseline performance. Similarly, chronic stress impairs working memory, attention, and executive functioning, leading to a reduced baseline capacity. Within a constrained environment, anxiety symptoms may have a limited impact, as cognitive functioning has already been depressed to a point where further decline may not be detected (Lupien et al., 2009).

This pattern is consistent with a floor effect: when environmental stressors depress cognitive performance to a uniformly low baseline across the sample, the additional variance attributable to anxiety becomes statistically undetectable. Floor effects arise in populations experiencing chronic adversity because multiple risk factors—poverty, malnutrition, disrupted schooling, violence exposure—compound to suppress performance, leaving insufficient distributional spread for anxiety-specific effects to emerge (Plomin et al., 2013). This does not imply that anxiety has no cognitive effects in this population; rather, it suggests that environmental adversity may act as a suppressor variable that obscures anxiety's contribution when examined in isolation. Future studies employing matched control designs or statistical adjustments for socioeconomic confounders may reveal associations that remain hidden in the present analysis.

The KABC-II subtests, while culturally appropriate and broad in scope, may not be sensitive enough to detect the executive attention processes that are most vulnerable to anxiety-related interference. ACT postulates that anxiety selectively disrupts executive attention functions (Eysenck et al., 2007). However, the KABC-II primarily assesses general cognitive abilities and may lack the granularity to isolate these specific functions. The

absence of a significant association may reflect measurement sensitivity rather than a genuine lack of effect (Kaufman et al., 2005).

Three explanatory frameworks warrant consideration for the preponderance of non-significant findings. First, contextual suppression: the uniformly adverse environmental conditions experienced by this sample may have created a floor effect in cognitive performance that obscures anxiety-specific variance. When environmental stressors depress performance to a uniformly low baseline across all participants, the additional variance attributable to anxiety becomes statistically undetectable. Second, measurement sensitivity: the KABC-II was not designed to isolate the executive attention processes that ACT identifies as most anxiety-vulnerable, and may lack the specificity required to detect subtle anxiety-related deficits within an already-impaired sample. Third, cultural divergence: ACT's predictions derive from Western samples with higher cognitive baselines and fewer chronic environmental stressors; the anxiety–cognition pathway may operate differently when both anxiety and environmental adversity are chronically elevated. Disentangling these explanations requires future research employing matched designs, anxiety-specific cognitive batteries, and multivariate modelling of contextual confounders.

An additional consideration is that the role of culture is shaping the expression of anxiety symptoms. The presentation of symptoms is not universal but is influenced by cultural context, norms, and idioms of distress. Among South African adolescents, anxiety may manifest more somatically, contrasting with the typically emphasised Western symptoms and models (Lewis-Fernández et al., 2011). Furthermore, stigma surrounding internalising disorders may discourage open reporting and may instead encourage alternative expressions of distress (Monnapula-Mazabane & Petersen, 2022). These variations in symptom expression may affect which cognitive domains are impacted or alter the time

course of impairment, potentially limiting the applicability of theories developed in Western contexts to the present study.

Measurement limitations of both instruments also merit explicit discussion. The GAD-7, while well-validated in South Africa (Henn & Morgan, 2019), was developed to screen for generalised anxiety disorder symptoms within Western psychiatric frameworks. In populations where anxiety manifests somatically or relationally — patterns documented in South African and African contexts (Sweetland et al., 2014; Muris et al., 2002) — the GAD-7 may underestimate true anxiety burden, contributing to attenuated associations with cognitive outcomes. Similarly, the KABC-II, though validated in South Africa (Mitchell et al., 2018), employs Western normative standards. Scores below the normative mean do not necessarily reflect cognitive deficit in an absolute sense; rather, they reflect performance relative to a standardisation sample that does not represent this population's true cognitive distribution. These measurement constraints collectively limit the precision with which anxiety–cognition associations can be estimated and should be considered when interpreting both the significant and non-significant results.

A significant association did occur between severe symptoms of anxiety and Pattern Reasoning (timed); however, once Bonferroni correction was applied, there was no longer a significant association. The Bonferroni correction controls Type I errors, which are false positives that can occur when conducting multiple analyses on the same dataset. It is a conservative measure and may increase Type II error, which may mask genuine associations between anxiety and cognitive functioning. This significant finding aligns with broader empirical research, which suggests that the effects of anxiety symptoms may not be uniform across all cognitive domains (Calhoun & Mayes, 2005; Mayes & Calhoun, 2007; Schoen & Holtzer, 2017).

5.6.1 The impact of severe symptoms of anxiety and the Pattern Reasoning (timed) subtest through an Attentional Control Lens.

In the current study, a significant association was observed between severe anxiety symptoms and performance on the Pattern Reasoning (timed) subtest of the KABC-II; however, this association did not remain significant after Bonferroni correction. The Pattern Reasoning subtest measures fluid intelligence and planning under strict time constraints, which places high demands on sustained attention, working memory, and executive control (Dehn, 2017; Kaufman et al., 2005).

This isolated significant association warrants careful interpretation. The Pattern Reasoning (timed) subtest is unique among the battery in imposing strict time pressure, a condition that ACT specifically predicts will exacerbate anxiety-related attentional disruption (Eysenck et al., 2007). Under time constraints, anxious individuals have reduced opportunity to compensate for attentional capture through increased effort, making performance decrements more likely to emerge. The absence of a significant association in the untimed version of the same subtest supports this interpretation, suggesting it is the interaction between anxiety and time pressure rather than planning ability per se, that drives the effect. Notably, however, the standardised residual analysis revealed a higher-than-expected proportion of severely anxious participants in the Upper Average range, a counterintuitive finding discussed in Chapter 5.6.1. After Bonferroni correction, this association no longer met the adjusted threshold ($\alpha = .0083$), indicating the finding should be interpreted as hypothesis-generating rather than confirmatory.

ACT provides a valuable lens for understanding these findings. It posits that anxiety disrupts the balance between top-down goal-directed attention and bottom-up stimulus-driven attention. This can lead to increased distractibility by external stimuli, which in turn impacts the efficiency of executive processes. ACT postulates that the three executive functions most

vulnerable to anxiety interference are inhibition, shifting, and updating. Under these conditions of severe anxiety symptoms, accuracy can sometimes be preserved through compensatory efforts; however, efficiency is often reduced, and overall cognitive load is increased (Eysenck et al., 2007). This distinction is reflected in the findings of the current study. Participants performed relatively better in the untimed version of the subtest, where they could employ compensatory strategies; however, their performance decreased when the time limit reduced the opportunity for compensation (Eysenck et al., 2007).

Individuals with compromised inhibitory control struggle to filter out irrelevant stimuli. Under time pressure, they have less time to filter out distractions and refocus, resulting in incomplete or less accurate tasks. Similarly, rapid shifting is required in reasoning tasks; time pressure may make this deficit more noticeable as individuals have to work harder to update and retain information (Eysenck & Derakshan, 2011). These combined pressures make reasoning tasks under time limits particularly sensitive to the disruptive effects of anxiety.

The observed effect in the timed Pattern Reasoning subtest, therefore, remains theoretically meaningful in light of ACT, even if not statistically robust after correction.

Although most participants with severe anxiety performed worse under time pressure, standardised residual analysis indicated that a higher-than-expected number fell in the Upper Average range on the timed Pattern Reasoning task. Notably, some individuals with severe anxiety were able to perform effectively, which seemingly contradicts ACT but is actually consistent with the theory, which postulates that exerting additional effort and recruiting more cognitive resources, a phenomenon known as overcompensation, can maintain performance effectiveness despite reduced efficiency. This approach enables successful short-term performance but is unsustainable in the long run (Eysenck et al., 2007).

These findings prompt reconsideration of whether ACT's fundamental assumptions hold across cultural contexts. The theory presumes a baseline of cognitive capacity from which anxiety-related decrements are measurable. Yet in populations where environmental constraints have already depressed cognitive performance to borderline/below-average ranges, the conceptual space for anxiety to exert additional measurable effects may not exist. This challenges researchers to develop theories accounting for ceiling and floor effects in adverse contexts, rather than assuming universal cognitive-affective relationships.

An important limitation in interpreting the present findings is the absence of statistical control for confounders plausibly associated with both anxiety and cognitive performance. Socioeconomic status, violence exposure, school quality, HIV status, language of testing, and household adversity represent key variables that were not included in the analytic models (Eysenck et al., 2007; Patel et al., 2016). In a sample where these factors are highly prevalent and intercorrelated, their omission means observed associations and observed null associations should be interpreted with caution. It is possible that multivariable adjustment would reveal anxiety–cognition associations that are obscured in bivariate analyses by shared confounding, or conversely, that apparent associations would attenuate to non-significance once contextual adversity is controlled. Future research employing pre-specified confounder adjustment is strongly recommended.

5.7 Implications

These findings carry substantial implications across theoretical, clinical, educational, and policy domains. At the theoretical level, the results challenge the universal applicability of Western-derived models of anxiety-cognition relationships. The minimal anxiety-cognition association suggests that ACT may not adequately account for individuals living in a context where they are exposed to chronic environmental stress, where adaptations may occur to manage this stress. This has implications for the anxiety-cognition association. This does not

nullify ACT but rather highlights the need for the development of nuanced theoretical frameworks that explicitly incorporate contextual factors, including allostatic load, stress inoculation effects, and culturally specific symptom expression, when exploring the association between anxiety and cognitive functioning. Future theoretical development should consider how chronic adversity may recalibrate both anxiety responses and cognitive processes in ways that fundamentally alter their interrelationships.

For clinical practice, the findings underscore the necessity of culturally adapted assessment, as standard screening tools may not adequately capture anxiety symptoms in populations where somatic rather than cognitive manifestations are prominent. Within the South African context, clinicians should supplement self-report measures with clinical interviews that explore culturally relevant idioms of distress and somatic presentations. Additionally, the high baseline prevalence of anxiety symptoms combined with widespread cognitive performance challenges suggests that interventions must address both individual symptomatology and structural determinants of mental health. School-based mental health programmes that integrate anxiety management with academic support may prove more effective than either approach in isolation.

Educational implications are essential as cognitive performance appears to be strongly influenced by socioeconomic and environmental factors. This highlights the need to target both symptoms of anxiety while concurrently enhancing cognitive development through enriched learning environments, improved nutrition, early childhood stimulation programmes, and the reduction of environmental stressors.

Policymakers should urgently invest in integrated adolescent mental health and education systems, given the high prevalence of anxiety and widespread cognitive performance challenges. Previous research indicates that school-based mental health programmes and lay counsellor intervention approaches have been effective in improving

mental health outcomes in low-resource communities (Barry et al., 2013; Patel et al., 2017). These models are particularly valuable in contexts like KwaZulu-Natal, where access to trained professionals may be limited. Expanding such initiatives may reduce the cognitive and emotional burdens that impact learning and development.

Simultaneously, policies addressing structural determinants, poverty reduction, violence prevention, educational resource allocation, nutritional support, and HIV treatment access are essential in supporting adolescent development. The findings suggest that adolescent mental health and cognitive outcomes cannot be treated as separable from socioeconomic conditions.

These findings challenge assumptions of anxiety being associated with uniform cognitive functioning impairment, advocating for tailored, context-sensitive assessments and interventions. This highlights the need for policymakers, educators, and community health workers to collaborate, ensuring equitable access to mental health resources and enriched educational environments, which enable adolescents to reach their full cognitive potential.

5.8 Conclusion

The discussion highlights that the prevalence of anxiety symptoms in this study's population substantially exceeds typical rates reported among adolescents in high-income countries, yet aligns closely with other South African findings. This high prevalence may reflect the influence of socioeconomic conditions and environmental stressors characteristic of peri-urban KwaZulu-Natal communities. This underscores the importance of addressing adolescent mental health within this context. In addition, the results revealed no statistically significant association between anxiety symptoms and cognitive functioning, except for performance on the Pattern Reasoning (timed) subtest. This suggests that timed tasks may impact the anxiety-cognition association. Together, these findings extend the existing

literature by providing evidence from a South African adolescent sample and highlighting important implications for educational, clinical, and policy development.

The next chapter concludes the dissertation by addressing the limitations and future implications for future research and practice.

Chapter 6

Conclusion

6.1 Summary of findings

The current study aimed to identify the prevalence of mild and severe anxiety symptoms among 945 adolescents residing in KwaZulu-Natal, South Africa, and to explore the impact of these symptoms on cognitive performance. Quantitative descriptive analysis was conducted, and Attentional Control Theory (ACT) served as the theoretical framework to examine the relationship between anxiety and cognition. The Generalised Anxiety Disorder 7-item scale (GAD-7) was used to assess the severity of anxiety, and the Kaufman Assessment Battery for Children Second Edition (KABC-II) was used to measure cognitive performance; both are widely used, psychometrically sound tests.

The findings revealed that symptoms of anxiety were prevalent within the sample (50.7% no anxiety, 32.8% mild, 12.1% moderate, 4.4% severe), likely influenced by broader social and environmental factors such as poverty, food insecurity, exposure to violence, and limited access to mental health care. Furthermore, there was no significant difference in symptoms of anxiety among different sexes or age groups. Thus supporting the notion that a flattening effect may occur due to the social and environmental factors at play.

In terms of cognitive performance, the distribution of scores across the KABC-II subtests deviated from the expected normal distribution typically seen in standardised assessments. Rather than forming a bell-shaped curve centred around the Average range, the majority of scores fell within the Low Average, Borderline, and Extremely Low categories, indicating that overall performance was below normative expectations.

The impact of anxiety symptoms on cognitive performance was subsequently examined, and the results showed no significant association between anxiety symptoms and overall cognitive functioning across five of the six KABC-II subtests (Atlantis, Atlantis

Delayed, Pattern Reasoning (Untimed), Hand Movements, Rover). This finding contrasts with the existing literature.

A significant relationship did emerge between severe anxiety symptoms and performance on the Pattern Reasoning (Timed) subtest. This subtest draws on executive functions, including working memory, inhibition, and cognitive flexibility, and imposes strict time constraints. However, when the Bonferroni correction was applied ($p = 0.0083$), the result was no longer significant. Bonferroni is considered a conservative measure; thus, it was still important to explore the potential reasons for its significance. This highlighted how executive functions may be impaired by anxiety, which can be understood through ACT. ACT proposes that anxiety disrupts executive processes, particularly in high-demand cognitive tasks, and may only impact certain domains of functioning.

Overall, the findings suggest that the impact of anxiety on cognitive performance should be considered within its broader context. Each cohort of individuals may respond differently depending on their social, environmental, and neurocognitive backgrounds. This study reinforces the idea that anxiety has domain-specific, rather than generalised effects on cognitive performance.

6.2 Limitations

Several limitations should be acknowledged when interpreting the findings of this study. Firstly, the study employed a cross-sectional design, which restricts the ability to establish a causal relationship between anxiety and cognitive performance. Associations can be observed, but this snapshot of recent functioning cannot determine the interplay of other unmeasured variables that may contribute to the observed outcome.

Secondly, symptoms of anxiety severity were measured with a self-report tool. Self-report tools are often subject to bias, such as social desirability and inaccurate self-perception. Additionally, the GAD-7 focuses mainly on cognitive symptoms, which may not

have been endorsed by individuals experiencing somatic symptoms of anxiety, which is prevalent amongst many cultures in South Africa. The tool may not have fully captured the physiological manifestations of anxiety that may be associated with cognitive functioning. Additionally, questionnaires restrict individuals to endorsing only one item, which may not provide a complete picture of their experience.

Thirdly, the generalisability of the study may not apply to the broader South African population, particularly in terms of rural versus urban differences, language groups, and cultural diversity.

Lastly, the analysis did not include potential moderating or confounding factors, such as socio-economic factors, prenatal factors, early childhood stimulation, and HIV/AIDS, which may impact cognitive development and functioning.

Despite these limitations, the study provides important insights and contributes meaningfully to the literature on the association between symptoms of anxiety and cognitive functioning in low-resource contexts.

Additional limitations should be acknowledged. Complete-case analysis was employed, whereby the 181 participants who did not complete all GAD-7 items were excluded. If missingness was related to anxiety severity (e.g., more symptomatic individuals less likely to complete), this introduces complete-case bias that may underestimate true prevalence. Sparse cell frequencies in several chi-square analyses reduced statistical power, increasing the risk of Type II error (failing to detect true associations). The absence of multivariable modelling means that confounding by socioeconomic and health-related variables cannot be ruled out. The exclusion of the moderate anxiety group from cognitive comparisons, necessitated by the research design, means that dose-response patterns across the full anxiety severity spectrum were not examined. Finally, the absence of age-appropriate

KABC-II norms for 19-year-olds introduces measurement imprecision for this age group, as discussed in Chapter 3.

6.3 Future recommendations

Several research directions emerge from these findings that could substantially advance understanding of anxiety-cognition relationships in under-resourced contexts. A longitudinal measure of anxiety symptoms and cognitive functioning over time is imperative to explore the anxiety-cognition association. This would provide insight into whether anxiety contributes to cognitive changes and how external factors may influence each of these factors, and whether they play a mediating role. Furthermore, it would clarify temporal relationships, identify critical periods when anxiety may exert the greatest impact, and reveal whether the associations observed in Western populations emerge at different developmental stages within South African contexts.

Methodological refinement represents another priority. Future studies should employ multimodal anxiety assessment combining self-report measures with clinical interviews that explore culturally relevant symptoms, given the context and different cultural experiences of anxiety. This would provide a more comprehensive understanding of the experience of anxiety within South Africa and how unique experiences may impact the anxiety-cognition association differently. Additionally, future research could include a more representative sample of South African adolescents, which would enhance the generalisability of the findings.

Finally, future research could focus on the investigation of moderating and mediating variables would enhance understanding of when and how anxiety affects cognition. Understanding these pathways could identify intervention targets beyond anxiety symptoms themselves.

Specific actionable recommendations for practice include: (1) School counsellors in KwaZulu-Natal should implement brief GAD-7 screening at the start of each academic year to identify at-risk adolescents before cognitive impacts accumulate. (2) Identified high-anxiety learners should be referred to school-based cognitive-behavioural support programmes, adapted for isiZulu-speaking adolescents and co-facilitated by community mental health workers. (3) Teachers should receive training in anxiety-sensitive pedagogy, including avoidance of timed assessments for identified high-anxiety learners where possible. (4) Provincial health departments should integrate mental health screening into existing adolescent wellness services at community health centres in peri-urban eThekwini districts. (5) The Asenze Study infrastructure should be leveraged for a follow-up longitudinal analysis examining whether anxiety predicts cognitive trajectories across waves, enabling causal inference beyond what the current cross-sectional design permits.

6.4 Conclusion

The present study examined the prevalence of anxiety symptoms and their association with cognitive performance among South African adolescents in a peri-urban KwaZulu-Natal context. The findings revealed that nearly half of this population experienced symptoms of anxiety at varying levels. This study contributes to a growing body of evidence highlighting that anxiety is highly prevalent and suggests that socio-environmental factors may shape it.

The results showed minimal association with cognitive performance measured through the KABC-II subtests; however, findings from the timed Pattern Reasoning subtest suggest that anxiety may have domain-specific effects that emerge under time constraints. The minimal anxiety-cognition association is an unexpected result that challenges the global research and the universal applicability of Attentional Control Theory. The findings underscore how chronic environmental adversities such as poverty, violence exposure, educational inequality, HIV burden, and limited access to resources that support healthy

development may fundamentally change emotional and cognitive outcomes, thus reshaping the relationships between emotional and cognitive functioning. Thereby, contradicting Western theories' predictions.

This study highlights the importance of interventions across theoretical, clinical, educational and policy domains and urges for implementation of interventions that address both mental health and cognitive development. Interventions addressing only anxiety symptoms or only cognitive deficits in isolation will likely prove insufficient. Effective approaches must acknowledge and address the systemic factors that constrain both emotional and cognitive development.

Overall, this analysis deepens understanding of the anxiety-cognition relationship among adolescents in peri-urban South Africa and points towards integrated policy measures that expand mental health services while strengthening cognitive development.

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Appendices

Appendix 1: Approval Letters

education

Department:
Education
PROVINCE OF KWAZULU-NATAL

Enquiries: Phindile Duma | Tel: 033 392 1063 | Ref.:2/4/8/1895

Dr C Desmond
Centre for Rural Health
Private Bag C54001
Durban
4000

Dear Dr Desmond

PERMISSION TO CONDUCT RESEARCH IN THE KZN DoE INSTITUTIONS

Your application to conduct research entitled: "**ASENZE STUDY OF RISK AND PROTECTION IN ADOLESCENCE**", in the KwaZulu-Natal Department of Education Institutions has been approved. The conditions of the approval are as follows:

1. The researcher will make all the arrangements concerning the research and interviews.
2. The researcher must ensure that Educator and learning programmes are not interrupted.
3. Interviews are not conducted during the time of writing examinations in schools.
4. Learners, Educators, Schools and Institutions are not identifiable in any way from the results of the research.
5. A copy of this letter is submitted to District Managers, Principals and Heads of Institutions where the Intended research and interviews are to be conducted.
6. The period of investigation is limited to the period from 12 August 2019 to 10 January 2022.
7. Your research and interviews will be limited to the schools you have proposed and approved by the Head of Department. Please note that Principals, Educators, Departmental Officials and Learners are under no obligation to participate or assist you in your investigation.
8. Should you wish to extend the period of your survey at the school(s), please contact Miss Phindile Duma at the contact numbers below.
9. Upon completion of the research, a brief summary of the findings, recommendations or a full report/dissertation/thesis must be submitted to the research office of the Department. Please address it to The Office of the HOD, Private Bag X9137, Pietermaritzburg, 3200.
10. Please note that your research and interviews will be limited to schools and institutions in KwaZulu-Natal Department of Education.

Pinetown District

[redacted]

Dr. EV Nzama
Head of Department: Education
Date: 14 August 2019

..Championing Quality Education - Creating and Securing a Brighter Future

KWAZULU-NATAL DEPARTMENT OF EDUCATION
Postal Address: Private Bag X9137 • Pietermaritzburg • 3200 • Republic of South Africa
Physical Address: 247 Burger Street • Anton Lembede Building • Pietermaritzburg • 3201
Tel.: +27 33 392 1063 • **Fax.:** +27 033 392 1203• **Email:**Phindile.Duma@kzndoe.gov.za •**Web:**www.kzneducation.gov.za
Facebook: KZNDOE....Twitter: @DBE_KZN....Instagram: kzn_education....Youtube:kzndoe

health
Department:
Health
PROVINCE OF KWAZULU-NATAL

DIRECTORATE: CORPORATE SERVICES

83 King Cetshwayo Highway
Mayville, Durban, 4001
Tel: 031 240 5455 Email:
www.kznhealth.gov.za

ETHEKWINI HEALTH DISTRICT OFFICE

23rd May 2019

Dear Chris Desmond

Re: Permission To Conduct Research at eThekwini District Facilities.

This letter serves to confirm that your application to conduct the research study titled, "Asenze Study of Risk and Protection in Adolescence " in the eThekwini has been recommended: In it they will use a socio-ecological model with a life course perspective to prospectively investigate factors linked to drug use, binge drinking and unprotected sex including adolescent attributes such as executive function, and past and current family and contextual factors. Though the cohort is population base, it may involve referrals to your facility when needed.

Kindly upload this letter together with your application as required to the Health Research and Knowledge Unit for the KZN Department of Health for Approval.

Please also note the following:

1. This research project should only commence after final approval by the KwaZulu-Natal Health Research and Knowledge Unit, and full ethical approval, has been granted,
2. That you adhere to all the policies, procedures, protocols and guidelines of the Department of Health with regards to this research.
3. All research activities must be conducted in a manner that does not interrupt clinical care at the health care facility,
4. Ensure that this office is informed before you commence your research
5. The District Office/Facility will not provide any resources for this research
6. All logistical details must be arranged with the CEO/medical manager /operational manager of the facility,
7. You will be expected to provide feedback on your findings to the District Office/Facility

Yours sincerely

[redacted]

Dr N Green(District Research Coordinator)
Pp Ms. T. P. Msimango
Chief Director (Acting)
eThekwini Health District

health
Department:
Health
PROVINCE OF KWAZULU-NATAL

Physical Address: 330 Langalibalele Street, Pietermaritburg
Postal Address: Private Bag X9051
Tel: 033 395 2805/ 3189/ 3123 Fax: 033 394 3782
Email:
www.kznhealth.gov.za

DIRECTORATE:
Health Research & Knowledge Management

NHRD Ref: KZ_201903_019

Dear Dr C. Desmond
Human Sciences Research Council

Approval of research

1. The research proposal titled **'Asenze study of risk and protection in adolescence'** was reviewed by the KwaZulu-Natal Department of Health.

   The proposal is hereby **approved** for research to be undertaken in The Valley Trust community. Participants who need treatment will be referred to the Department of Health facilities.

2. You are requested to take note of the following:
   a. Kindly liaise with the facility manager BEFORE your research begins in order to ensure that conditions in the facility are conducive to the conduct of your research. These include, but are not limited to, an assurance that the numbers of patients attending the facility are sufficient to support your sample size requirements, and that the space and physical infrastructure of the facility can accommodate the research team and any additional equipment required for the research.
   b. Please ensure that you provide your letter of ethics re-certification to this unit, when the current approval expires.
   c. Provide an interim progress report and final report (electronic and hard copies) when your research is complete to **HEALTH RESEARCH AND KNOWLEDGE MANAGEMENT, 10-102, PRIVATE BAG X9051, PIETERMARITZBURG, 3200** and e-mail an electronic copy to hrkm@kznhealth.gov.za

For any additional information please contact Mr X. Xaba on 033-395 2805.

Yours Sincerely

[redacted]

Dr E Lutge

Chairperson, Health Research Committee

Date: 05/07/19

A Centre for Health Promotion
Registration No.: NPO 002-280; PBO 18/11/13/2817
PO BOX 33, BOTHAS HILL, 3660, KWAZULU-NATAL, SOUTH AFRICA
TELEPHONE: +27 (31) 716 6800; FAX: +27 (31) 777 1114 E-MAIL: info@vtrust.org.za; WEBSITE: www.thevalleytrust.org.za

6 March 2019

Re: Asenze Research Project

To Chris Desmond (Principal investigator),

This letter serves to confirm that that the organisation The Valley Trust (TVT) are in full support of the research that will be conducted at our premises in Zulu Reserve Road, Bothas Hill. It has been agreed upon and formalised through a lease agreement that the project will rent buildings from TVT from which the research will be run over a period of 3 years.

We look forward to a fruitful partnership.

Warm regards,

[redacted]

S'bongiseni Vilakazi

Executive Director

The Valley Trust

Tel: 031-716 6800

[redacted]

www.thevalleytrust.org.za

Appendix 2: Ethical Approval

UNIVERSITY OF KWAZULU-NATAL
INYUVESI YAKWAZULU-NATALI

13 May 2023

Dr C Desmond
School of Nursing and Public Health
Health Sciences
chrisdesmondsa@gmail.com

Dear Dr Desmond

Protocol: Asenze study of risk and protection in adolescence.
Degree: Non-Degree
BREC Ref No: BE609/18

RECERTIFICATION APPLICATION APPROVAL NOTICE

Approved:	26 April 2023
Expiration of Ethical Approval:	25 April 2024

I wish to advise you that your application for Recertification for the above protocol has been **noted and approved** by a sub-committee of the Biomedical Research Ethics Committee (BREC) for another approval period. The start and end dates of this period are indicated above.

If any modifications or adverse events occur in the project before your next scheduled review, you must submit them to BREC for review. Except in emergency situations, no change to the protocol may be implemented until you have received written BREC approval for the change.

The committee will be notified of the above approval at its next meeting to be held on 13 June 2023.

Yours sincerely

[redacted]

Ms A Marimuthu
(for) Prof D Wassenaar
Chair: Biomedical Research Ethics Committee

UNIVERSITY OF KWAZULU-NATAL
INYUVESI YAKWAZULU-NATALI

26 April 2019

Dr C Desmond
School of Nursing and Public Health
Health Sciences
chrisdesmondsa@gmail.com

Dear Dr Desmond

Protocol: Asenze study of risk and protection in adolescence.
Degree: Non-Degree **BREC Ref No: BE609/18**

EXPEDITED APPLICATION: APPROVAL LETTER

A sub-committee of the Biomedical Research Ethics Committee has considered and noted your application received 04 October 2018.

The study was provisionally approved pending appropriate responses to queries raised. Your response received on 03 April 2019 to BREC correspondence dated 22 October 2018 has been noted by a sub-committee of the Biomedical Research Ethics Committee. The conditions have been met and the study is given **full ethics approval** and may begin as from 26 April 2019. Please ensure that site permissions are obtained and forwarded to BREC for approval before commencing research at a site.

This approval is valid for one year from **26 April 2019.** To ensure uninterrupted approval of this study beyond the approval expiry date, an application for recertification must be submitted to BREC on the appropriate BREC form 2-3 months before the expiry date.

Any amendments to this study, unless urgently required to ensure safety of participants, must be approved by BREC prior to implementation.

Your acceptance of this approval denotes your compliance with South African National Research Ethics Guidelines (2015), South African National Good Clinical Practice Guidelines (2006) (if applicable) and with UKZN BREC ethics requirements as contained in the UKZN BREC Terms of Reference and Standard Operating Procedures, all available at http://research.ukzn.ac.za/Research-Ethics/Biomedical-Research-Ethics.aspx.

BREC is registered with the South African National Health Research Ethics Council (REC-290408-009). BREC has US Office for Human Research Protections (OHRP) Federal-wide Assurance (FWA 678).

The sub-committee's decision will be noted by a full Committee at its next meeting taking place on **14 May 2019.**

We wish you well with this study. We would appreciate receiving copies of all publications arising out of this study.

Yours sincerely

[redacted]

Professor V Rambiritch
Chair: Biomedical Research Ethics Committee

Co investigators: kvalsvig@gmail.com Naidoos71@ukzn.ac.za ljd1@colombia.edu

UNIVERSITY OF KWAZULU-NATAL
INYUVESI YAKWAZULU-NATALI

09 September 2024

Shannon Jean Mayo (219060355)
School of Applied Human Sc
Pietermaritzburg Campus

Dear SJ Mayo,

Protocol reference number: HSSREC/00007313/2024
Project title: The impact of anxiety on cognitive functioning among a cohort of adolescents living in KwaZulu-Natal, South Africa.
Degree: Masters

Approval Notification – Expedited Application

This letter serves to notify you that your application received on 28 June 2024 in connection with the above, was reviewed by the Humanities and Social Sciences Research Ethics Committee (HSSREC) and the protocol has been granted **FULL APPROVAL**.

Any alteration/s to the approved research protocol i.e. Questionnaire/Interview Schedule, Informed Consent Form, Title of the Project, Location of the Study, Research Approach and Methods must be reviewed and approved through the amendment/modification prior to its implementation. In case you have further queries, please quote the above reference number.

PLEASE NOTE: Research data should be securely stored in the discipline/department for a period of 5 years.

Incidents of adverse events and serious adverse events (AEs and SAEs) should be reported in writing to HSSREC, the study sponsors, and any regulatory authority (where appropriate), within 7 working days of the occurrence for local sites and 14 days for all other South African sites.

This approval is valid until 09 September 2025.
To ensure uninterrupted approval of this study beyond the approval expiry date, a progress report must be submitted to the Research Office on the appropriate form 2 - 3 months before the expiry date. A close-out report to be submitted when study is finished.

HSSREC is registered with the South African National Health Research Ethics Council (REC-040414-040).

Yours sincerely,

[redacted]

Professor Dipane Hlalele (Chair)

/nng

Appendix 3: Data sharing approval

22 April 2024

Dear Chair, UKZN ethics review board

This letter is to confirm that Shannon Mayo (Student Number: 219060355) has obtained permission to utilise data from wave 3 of the Asenze study for the purpose of conducting research for her Masters in Social Science Counselling Psychology degree. The focus of her research is on investigating the impact of anxiety on cognitive functioning within the cohort.

Once Ms Mayo has finalised the specifications of her thesis, she is required to submit a data analysis plan to the Asenze team and upon completion of her t she will be required to submit a copy of the thesis together with her data analysis record. Any subsequent publications will require additional approval by the study PI's.

Sincerely,

[redacted]

Chris Desmond, PI
Research Associate
Centre for Rural Health, UKZN
E-mail: chrisdesmond@libstudies.com

Appendix 4: Informed Consent Form

INFORMATION SHEET AND INFORMED CONSENT FORM FOR ENROLLMENT OF CAREGIVER/ ASSENT FORM FOR ENROLMENT OF PARTICIPANTS YOUNGER THAN 18 YEARS

If the child is unable to read, this form must be read to the exactly as written, in their chosen language and a witness must sign this form to confirm that the correct information was given and the child has willingly assented to be in this study.

Greeting:

Good day, my name is _____ (researcher name). I am from the University of KwaZulu-Natal. We are conducting a research study about young people's health, behaviour and well-being in *Kwadedangendlale area*. We are working with Columbia University on this study, as we were when you participated previously. You are invited to participate in this research study.

Introduction:

You and your caregiver participated in two previous parts of the Asenze research study in 2008 and 2010. These assessments were about understanding and improving young children's health and development. As an adolescent we would like to ask you and to participate in the Asenze study again.

In this wave of the study, we are trying to understand what helps young people to make good decisions and do well in life, and what causes young people to struggle in life and make risky decisions. We would like to find out how early childhood conditions, family life and difficulties in a community can cause some adolescents to engage in risky behaviour, such as drug and alcohol misuse and unprotected sex. These risky behaviours increase adolescents' chances of becoming HIV positive and can have other negative outcomes such as school failure or adolescent pregnancy. We also want to know why some adolescents do well despite difficult circumstances, and what strengths in families and communities can help adolescents do well today and in the future. If we can learn more about why adolescents engage in risky behaviour, we can plan ways to help communities and families support and care for children so that these children are able to make safe decisions as they grow older.

This research study has an office in The Valley Trust's building, but it is not part of The Valley Trust and The Valley Trust is not a partner in this research.

If you agree to participate in the study, you will be asked to sign this assent form, and you will be given a copy of the Information Sheet to keep for future reference. If you cannot sign your name, you can make a mark while someone else is watching.

Invitation to participate:

We are asking you to participate in a research study. Since you are younger than 18 years of age you cannot agree on your own to participate in this study.

- **Consent** is the permission your adult caregiver gives for you to join in the study.
- **Assent** is your agreement to join in this study because you are under 18 years of age.

If your caregiver agrees (consents) to you joining in the study, we will still need you to agree (assent) to join in this study before you participate. Even if your caregiver agrees (consents) to you joining in the study you do not have to give your agreement (assent). You can still choose not to be part of the study.

I will tell you and your caregiver about this study and explain what being a participant in the study would involve, including what we will do, what we will expect you to do, and your rights as a participant.

What is involved in this study?

The study is expected to enroll the same 1,500 adolescents and their caregivers from the previous waves of the Asenze study. If you choose to enroll in the study, it will involve an assessment visit in the next few weeks.

We are asking permission to interview you. If you agree, the study's team will make an appointment with your caregiver to confirm a time for your interview and assessment. You and your caregiver will be interviewed and assessed at the studies offices at The Valley Trust. Your caregiver will not be present in the room when you are assessed.

We have been granted permission from the Department of Education (Ref.:2/4/8/1895) to speak to the principal of your school to get permission for you to be absent from school on the day of the interview. If the principal does not agree, you will be given an appointment on the weekend. On the day of your appointment the study driver will collect you and your caregiver from your home and drive you to the Asenze offices. When your appointment is complete the driver will take you back to your home.

Adolescent assessment:

If you give your consent, we will measure a number of things including your ability to think things through, to plan and to make decisions. You will be asked questions that measure your cognitive ability, social behaviour, relationships with peers, community, family life, mental health and health behaviours such as smoking, using alcohol or other drugs, and sexual behaviour.

We will measure your height, body weight, vision, and hearing to evaluate against your results from the last wave and to other data collected in research and clinical settings in KwaZulu-Natal and other South African populations.

The research study staff will not tell anyone else, including your caregiver, what you say in your assessment, and staff will not share any of your test results unless you give your permission or we are legally required to do so.

HIV and haemoglobin tests:

At your appointment at the study offices we will offer HIV rapid testing and counselling. We will also ask you to agree to a haemoglobin blood test. If you agree to have an HIV test, the results will be given to you immediately after the test. The results of your HIV rapid test will be recorded by the research study staff but will not be shared with caregiver unless you give your permission. If you test HIV positive we will provide you with on-site counselling and we will refer you to treatment and care through your local department of health clinic. We will also invite you back to visit the study offices a month later to be sure that you have received the referral and any services you may need.

The results of all HIV tests taken as part of the study may be shared with the Department of Health. The Department of Health will not be given your name. They will only given group information about the test results that can not be linked back to any one specific person.

Whether or not you agree to get the HIV test will not affect your or your participation in the study.

Access to school performance records

As part of this study we would like to ask your school for your school performance records. This information will help us learn about the relationship between a child's school performance, their adolescent years and their life as an adult. We will not ask the school for these records without your caregivers' consent to do so. If your caregiver does not agree to us asking your school for your school performance records you can still be part of the study.

Contact in future waves

If you participate in this wave of the study, we will contact you and your caregiver again in about a year and a half to ask if you would like to join in the fourth part of the study. You can still be part of the study now even if you do not want to join the study again in the future.

Risks and/or discomforts

Some of the issues that will be discussed and the questions that will be asked may make you feel uncomfortable, but you can choose to not answer any question at any time during the study.

As a result of participating in the study you may learn that you have a health or problem or behaviour difficulty that needs attention and treatment. If so, we will provide you with a referral letter for services in the area.

Benefits

We hope that you will directly benefit from the study by receiving a hearing, vision and psychosocial test. If you are found to have any physical or psychological problems the research study team will refer you to existing services and provide a referral letter as needed.

We hope you will benefit indirectly as your participation in this research could help us understand what is needed to support the wellbeing and development of children and adolescents in the *Kwadedangendlale* area, and how to work with the community to support children and adolescents in need.

You will not be responsible for the costs of any of the interviews, assessments, tests or transport.

Study approval

This study has been reviewed and approved by the UKZN Biomedical Research Ethics Committee approval, it has been given the number BE609/18 and the Columbia University of New York ethics committee (Institutional Review Board) and given the number of AAAC2559.

Voluntary participation and right to withdraw

Your participation in the study is voluntary. Even though you were part of the study in the past, you do not have to be part of the study again.

You do not have to answer any questions you do not want to answer. If there is a question you do not want to answer, you can choose to move on to the next question. You may also stop the interview and assessment at any time and decide to leave the study if you wish.

You may be removed from the study without your consent, although you will be informed, for the following reasons:

- The investigator decides that continuing in the study would be harmful to you.
- The study is cancelled by the University of KwaZulu-Natal Biomedical Research Ethics Committee of the Columbia University Institutional Review Board.
- Other administrative reasons.

If you agree to participate, we request that you sign this form and keep a copy which shows the names of individuals you can contact for further information about the study or to voice any concern or complaint about the interviews. If you cannot sign your name, you can make a mark while someone else is watching. You do not have to sign this form if you do not wish to.

Compensation

If you participate in this study you will be given compensation voucher of a minimum of R20 and up to R60, based on the outcome of your risk experiment. This is to thank you for your time and effort.

Confidentiality

The researchers will safeguard any information obtained during this study and make every effort to keep it confidential, unless we are legally required to share particular information with authorities.

Neither your name nor your caregiver's name will appear on the research forms or any of the reports. Instead, a unique study participant number will be assigned to you and used to identify your forms. A separate list which connects your name to the study number will be kept locked in a separate cabinet with electronic copies kept in a separate password-protected file.

Some of the information that we collect will be stored on a secure password-protected computer server hosted in the Google Cloud environment. This will NOT include any information that could identify you or your caregiver, such as name or date of birth. Only senior study staff will have password access to the information on the server.

Only information about groups that participated in the study will be reported. No information about you or your caregiver, or information that connects you to the study, will be given to anyone without your wish and your written permission.

All information collected about you and your caregiver during the study will be recorded and will only be available to the study staff at the University of KwaZulu-Natal and the Research Ethics Committee. It will be kept confidential to the extent permitted by law.

Problems and questions

If you ever have any questions about this study, or in the case of a research-related injury, you should contact Study Director Furzana Timol at 067 140 0048 or the Principal Investigator Dr. Chris Desmond 031 260 4500.

If you have any questions about research subject rights or complaints or problems regarding the research, please contact the UKZN Biomedical Research Ethics Committee, contact details as follows:

BIOMEDICAL RESEARCH ETHICS ADMINISTRATION	The Principal Investigators of the study are:	
Research Office, Westville Campus Govan Mbeki Building Private Bag X 54001 Durban, 4000 KwaZulu-Natal, SOUTH AFRICA Tel: 27 31 2604769 Fax: 27 31 2604609 Email: BREC@ukzn.ac.za	Dr Chris Desmond Centre for Rural Health University of KwaZulu-Natal Durban, 4000 South Africa Tel: 031 260 4500 Email: chrisdesmondsa@gmail.com	Dr Leslie Davidson Columbia University New York, New York USA Tel. 001212342-0247 Email: lld1@cumc.columbia.edu

The study staff will be happy to answer any questions or concerns you may have now or later.

Thank you for your time.

ASSENT STATEMENT AND SIGNATURE PAGE FOR ENROLMENT OF PARTICIPANTS YOUNGER THAN 18 YEARS

Participant copy

Assent statements to Participate in Research

- I have been asked to participate in a research study.
- I have been informed about the "Asenze study of risk and protection in South African adolescence".
- I understand the purpose and procedures of the study.
- I have been given an opportunity to ask questions about the study and have had answers to my satisfaction.
- I understand that my participation in this research project is voluntary, and that I may withdraw at any time.
- I understand that I will not be penalized or lose benefits, treatment or care that I would usually be entitled to if I refuse participate or if I decide to withdraw from this study.
- If I agree to participate, you will give me a copy of this document and the participant information sheet which is a written summary of the research.
- I have been informed about any available compensation or medical treatment if injury occurs to me as a result of study-related procedures.
- If I have any further questionsor concerns related to the study or if I am injured as a result of the research, I understand that I may contact Study Director, Furzana Timol at 067 140 0048 or Principal Investigator Dr. Chris Desmond at 031 260 4500.
- If I have any questions or concerns about my rights as a study participant, or if I am concerned about an aspect of the study or the researchers then I may contact:

Biomedical Research Ethics Office, Private Bag X54001, Durban

Telephone: +27 (0) 31 260 4769 / 260 4553
Fax: +27 (0) 31 260 4609
email: brec@ukzn.ac.za

- The research study, including the above information, has been described to me. I understand what my involvement in the study means and I voluntarily agree to participate. I thus provide my informed assent.

Assent for your Participation

Mandatory for participation in the study

I agree to participate in the study. Yes ☐ No ☐

Signature for consent

Print name of Participant	Signature or mark of Participant	Date

Print name of study staff who administered consent	Signature of study staff who administered consent	Date

When participant illiterate and has placed a mark as signature or has provided verbal consent, a witness will need to be present and their details filled in below.

Print name of Witness	Signature of Witness	Date

ASSENT STATEMENT AND SIGNATURE FOR ENROLMENT OF PARTICIPANTS YOUNGER THAN 18YEARS

For Office use - TO BE RETAINED BY UKZN		ChildTAG#	
Completed by		Date Completed	
Checked by		Date Checked	

Assent statements to Participate in Research

- I have been asked to participate in a research study.
- I have been informed about the "Asenze study of risk and protection in South African adolescence".
- I understand the purpose and procedures of the study.
- I have been given an opportunity to ask questions about the study and have had answers to my satisfaction.
- I understand that my participation in this research project is voluntary, and that I may withdraw at any time.
- I understand that I will not be penalized or lose benefits, treatment or care that I would usually be entitled to if I refuse participate or if I decide to withdraw from this study.
- If I agree to participate, you will give me a copy of this document and the participant information sheet which is a written summary of the research.
- I have been informed about any available compensation or medical treatment if injury occurs to me as a result of study-related procedures.
- If I have any further questionsor concerns related to the study or if I am injured as a result of the research, I understand that I may contact Study Director, Furzana Timol at 067 140 0048 or Principal Investigator Dr. Chris Desmond at 031 260 4500.

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- The research study, including the above information, has been described to me. I understand what my involvement in the study means and I voluntarily agree to participate. I thus provide my informed assent.

Assent for your Participation

Mandatory for participation in the study
I agree to participate in the study. Yes ☐ No ☐

Signature for consent

Print name of Participant	**Signature or mark of Participant**	**Date**

Print name of study staff who administered consent	**Signature of study staff who administered consent**	**Date**

When participant illiterate and has placed a mark as signature or has provided verbal consent, a witness will need to be present and their details filled in below.

Print name of Witness	**Signature of Witness**	**Date**

Asenze study of risk and protection in adolescence

ASSENT FORM FOR ENROLMENT OF PARTICIPANTS YOUNGER THAN 18 YEARS

ADMINISTRATIVE PAGE TO BE COMPLETED BY ASENZE STUDY STAFF

If the child is younger than 18 years of age, this administrative section must be completed prior to completing the consent / assent forms for enrolment.

1. Has the age of the participant been verified?

   ☐ Yes

   ☐ No

2. If yes, indicate below how the participant's age has been verified

   ☐ Birth Certificate

   ☐ Identification Document (ID)

   ☐ Other: Specify_____.

3. Who is the adult who has provided consent for this participant, younger than 18 years to participate in this study?

   ☐ Parent

   ☐ Legal Guardian

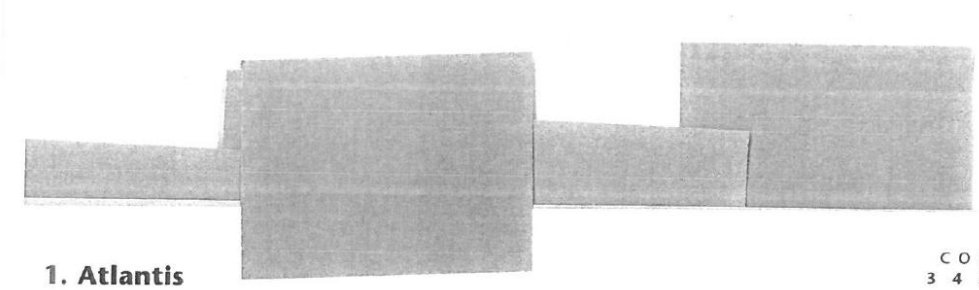
   ☐ Caregiver

   ☐ Other: Specify _____.

_____	_____	_____
Study staff member name (Print)	Study Staff signature	Date

If you have indicated NO to Question 1 and there is no adult consent indicated in Question 3, please do not proceed any further.

Appendix 5: KABC-II subtests



1. Atlantis

CORE 3 | CORE 4 5 6 | CORE 7–12 | CORE 13–18

Discontinue: at Item 11, 20, 29, or 42 if cumulative score is below the specified value

	Item	Score			Response
All ▶	1	0	1	2	KOH (fish)
	2	0	1	2	ZUKE (fish)
	3	0	1	2	KOH (fish)
	4	0	1	2	ZUKE (fish)
	5	0	1	2	LOPS (fish)
	6	0	1	2	LOPS (fish)
	7	0	1	2	NEEF (fish)
	8	0	1	2	KOH (fish)
	9	0	1	2	ZUKE (fish)
	10	0	1	2	DAB-lee (plant)
	11	0	1	2	NEEF (fish)
					Cumulative Score, Items 1–11 (max. = 22) STOP if 15 or less
	12	0	1	2	LOPS (fish)
	13	0	1	2	DAB-lee (plant)
	14	0	1	2	TY-lar (plant)
	15	0	1	2	KOH (fish)
	16	0	1	2	KOH (fish)
	17	0	1	2	TY-lar (plant)
	18	0	1	2	ZUKE (fish)
	19	0	1	2	NEE-dew (plant)
	20	0	1	2	NEEF (fish)
					Cumulative Score, Items 1–20 (max. = 40) STOP if 24 or less
	21	0	1	2	NEEF (fish)
	22	0	1	2	MAY-car (plant)
	23	0	1	2	KOH (fish)
	24	0	1	2	NEE-dew (plant)
	25	0	1	2	LOPS (fish)
	26	0	1	2	DAB-lee (plant)
	27	0	1	2	WIM-ple-mat (shell)
	28	0	1	2	NEEF (fish)
	29	0	1	2	MAY-car (plant)
					Cumulative Score, Items 1–29 (max. = 58) STOP if 38 or less
	30	0	1	2	KOH (fish)
	31	0	1	2	TY-lar (plant)
	32	0	1	2	WIM-ple-mat (shell)
	33	0	1	2	ZUKE (fish)
	34	0	1	2	DAB-lee (plant)
	35	0	1	2	JEN-a-lease (shell)
	36	0	1	2	no name (fish)
	37	0	1	2	LOPS (fish)
	38	0	1	2	SPEE-mar-ton (shell)
	39	0	1	2	ZUKE (fish)
	40	0	1	2	JEN-a-lease (shell)
	41	0	1	2	NEE-dew (plant)
	42	0	1	2	no name (fish)
					Cumulative Score, Items 1–42

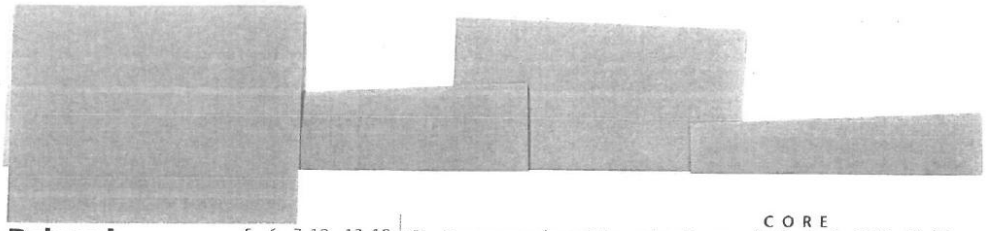
Item	Score			Response
43	0	1	2	TY-lar (plant)
44	0	1	2	SPEE-mar-ton (shell)
45	0	1	2	KOH (fish)
46	0	1	2	TROH-zen-dill (shell)
47	0	1	2	MAY-car (plant)
48	0	1	2	no name (shell)
49	0	1	2	DAB-lee (plant)
50	0	1	2	NEE-dew (plant)
51	0	1	2	TROH-zen-dill (shell)
52	0	1	2	NEEF (fish)
53	0	1	2	WIM-ple-mat (shell)
54	0	1	2	no name (plant)
				Cumulative Score, Items 1–54 (max. = 108)

▶ *If the child reached Item 54, write the cumulative score in the Raw Score box below the table on page 5.*

▶ *If the child stopped at Item 11, 20, 29, or 42, use the table on page 5 to convert the cumulative score to the Raw Score.*

QIs (optional) ***Atlantis***

- − Fails to sustain attention
- − Impulsively responds incorrectly
- − Reluctant to respond when uncertain
- − Responds negatively to correction
- + Unusually focused



8. Atlantis Delayed

5 6 7–12 13–18

Discontinue: at the designated stopping item, or after 4 consecutive scores of less than 2

Note: Do not administer if the child did not reach Item 4 on Atlantis.

Instructions: Before starting, circle the number of the highest Atlantis item reached to mark the row of the last Atlantis Delayed item to administer.

Highest Atlantis Item Reached (circle)	Item	Score	Response
All ▶	1	0 1 2	KOH (fish)
	2	0 1 2	ZUKE (fish)
4–5	3	0 1 2	LOPS (fish)
6–8	4	0 1 2	NEEF (fish)
9–11	5	0 1 2	DAB-lee (plant)
12–15	6	0 1 2	TY-lar (plant)
16–20	7	0 1 2	NEE-dew (plant)
21–24	8	0 1 2	MAY-car (plant)
25–29	9	0 1 2	WIM-ple-mat (shell)
30–36	10	0 1 2	JEN-a-lease (shell)
37–42	11	0 1 2	SPEE-mar-ton (shell)
43–54	12	0 1 2	TROH-zen-dill (shell)

____ Cumulative Score (if the child stopped before Atlantis Delayed Item 12)

If the child stopped before Item 12 on Atlantis Delayed, use the table below to convert the cumulative score to the Raw Score.

STEP 1									STEP 2
Cumulative Score at Atlantis Delayed Stopping Point									
Item 3	Item 4	Item 5	Item 6	Item 7	Item 8	Item 9	Item 10	Item 11	Raw Score
0	0	0	0	0	0	0	0	0	**0**
1	1	1	1	1	1	1	1	1	**1**
			2	2	2	2	2	2	**2**
2	2	2				3	3	3	**3**
	3	3	3	3	3		4	4	**4**
3		4	4	4	4	4	5	5	**5**
	4			5	5	5		6	**6**
		5	5		6	6	6	7	**7**
4			6	6		7	7	8	**8**
	5	6		7	7	8	8	9	**9**
			7	8	8	9	9	10	**10**
		7			9		10	11	**11**
	6		8	9		10	11		**12**
5					10	11	12	12	**13**
		8	9	10	11	12	13	13	**14**
								14	**15**
	7		10	11	12	13	14	15	**16**
						14	15	16	**17**
6		9		12	13	15	16	17	**18**
	8		11		14		17	18	**19**
		10		13		16		19	**20**
			12		15		18	20	**21**
				14	16	17	19		**22**
						18	20	21	**23**
								22	**24**

☐ **Raw Score** (max. = 24)

QIs (optional) ***Expressive Vocabulary***

\+ Perseveres

− Reluctant to respond when uncertain

9. Expressive Vocabulary

CORE 3 4 5 6 7–12 13–18

Basal: first 3 items passed, or drop back one start point as needed

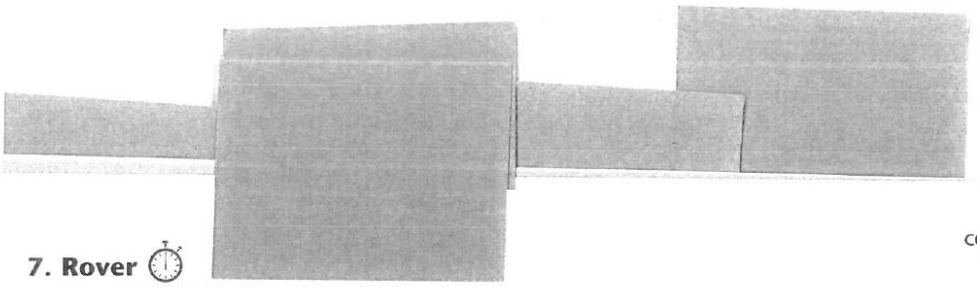
Discontinue: 4 consecutive scores of 0

	Item	Score	Response
3–4 ▶	1	0 1	dog
	2	0 1	chair
	3	0 1	banana
	4	0 1	TV
	5	0 1	book
	6	0 1	clock
5 ▶	7	0 1	spoon
	8	0 1	ear
	9	0 1	scissors
	10	0 1	window
6–11 ▶	11	0 1	cup
	12	0 1	flashlight
	13	0 1	drum
	14	0 1	zipper
	15	0 1	feather
	16	0 1	mailbox
	17	0 1	guitar
12–18 ▶	18	0 1	bench
	19	0 1	microphone
	20	0 1	arrow
	21	0 1	doorknob
	22	0 1	unicorn
	23	0 1	magnifying glass
	24	0 1	thermometer
	25	0 1	canoe
	26	0 1	tongue
	27	0 1	apron
	28	0 1	lens
	29	0 1	tusk
	30	0 1	sill
	31	0 1	(wooly) mammoth
	32	0 1	gargoyle
	33	0 1	crater
	34	0 1	drawbridge
	35	0 1	easel
	36	0 1	tread
	37	0 1	tripod
	38	0 1	stirrup
	39	0 1	serrated (edge)
	40	0 1	palette
	41	0 1	fret
	42	0 1	uvula
	43	0 1	(flying) buttresses
	44	0 1	clapper
	45	0 1	septum

____ Ceiling Item

____ minus errors

☐ **Raw Score** (max. = 45)



7. Rover

CORE 6 | CORE 7–12 | CORE 13–18

Discontinue: 5 consecutive scores less than 2

Instructions: • For Items 3 and 6–22, if the child breaks a rule while moving Rover, check the "Illegal Move" column and score 0 (or give the second trial).
• Score 0 if the response exceeds the time limit.

Item	Time Limit	Score				Correct # of Moves	Moves Taken	Illegal Move
All ▶ A						3		
1	:30	—	—	2	Trial 1	3		☐
		0	1	—	Trial 2			☐
2	:30	—	—	2	Trial 1	3		☐
		0	1	—	Trial 2			☐
3	:30	0	1	2		3		☐
	# of moves:	5+	4	3				
B						5		
4	:30	—	—	2	Trial 1	3		☐
		0	1	—	Trial 2			☐
5	:30	—	—	2	Trial 1	4		☐
		0	1	—	Trial 2			☐
6	:30	0	1	2		2		☐
	# of moves:	4+	3	2				
7	:30	0	1	2		4		☐
	# of moves:	6+	5	4				
8	:40	0	1	2		5		☐
	# of moves:	7+	6	5				
9	:45	0	1	2		5		☐
	# of moves:	7+	6	5				
10	:30	0	1	2		4		☐
	# of moves:	6+	5	4				
11	:45	0	1	2		6		☐
	# of moves:	8+	7	6				
12	:40	0	1	2		5		☐
	# of moves:	7+	6	5				
13	:45	0	1	2		6		☐
	# of moves:	8+	7	6				
14	:70	0	1	2		7		☐
	# of moves:	9+	8	7				
15	:45	0	1	2		5		☐
	# of moves:	7+	6	5				
16	:45	0	1	2		5		☐
	# of moves:	7+	6	5				
17	:75	0	1	2		7		☐
	# of moves:	9+	8	7				
18	:45	0	1	2		6		☐
	# of moves:	8+	7	6				
19	:70	0	1	2		8		☐
	# of moves:	10+	9	8				
20	:75	0	1	2		8		☐
	# of moves:	10+	9	8				
21	:80	0	1	2		8		☐
	# of moves:	10+	9	8				
22	:80	0	1	2		7		☐
	# of moves:	9+	8	7				

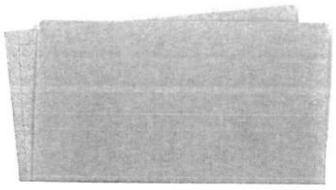
☐ Raw Score (max. = 44)

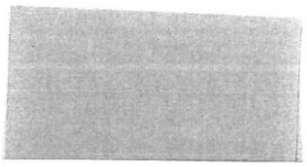
QIs (optional) ***Rover***

- – Fails to sustain attention
- – Impulsively responds incorrectly
- – Repeatedly breaks rules
- + Tries out options

QIs (optional) ***Atlantis Delayed***

- – Fails to sustain attention
- – Impulsively responds incorrectly
- – Reacts negatively to unexpected task
- – Reluctant to respond when uncertain





15. Pattern Reasoning

CORE 5 CORE 6 CORE 7–12 CORE 13–18

Basal: first 3 items passed, or drop back to Item 1

Discontinue: 4 scores of 0 in 5 consecutive items

Instructions: • **Use blue shaded areas for "time point" scoring (ages 7–18 only).**

• There are no time limits.

	Item	Score	Response
All ▶	S		A ___
5–8 ▶	1	0 1	B ___
	2	0 1	C ___
	3	0 1	D ___
	4	0 1	D ___
	5	0 1	B ___
9–18 ▶	6	0 1	D ___
	7	0 1	A ___
	8	0 1	C ___
	9	0 1	B ___
	10	0 1 2 ≤:10	B ___
	11	0 1 2 ≤:10	F ___
	12	0 1 2 ≤:10	C ___
	13	0 1 2 ≤:10	D ___
	14	0 1 2 ≤:15	B ___
	15	0 1 2 ≤:15	F ___
	16	0 1 2 ≤:10	A ___
	17	0 1 2 ≤:15	E ___
	18	0 1 2 ≤:15	C ___
	19	0 1 2 ≤:15	C ___
	20	0 1 2 ≤:15	E ___
	21	0 1 2 ≤:15	B ___
	22	0 1 2 ≤:15	B ___
	23	0 1 2 ≤:15	A ___
	24	0 1 2 ≤:20	B ___
	25	0 1 2 ≤:20	E ___
	26	0 1 2 ≤:25	B ___
	27	0 1 2 ≤:25	F ___
	28	0 1 2 ≤:20	E ___
	29	0 1 2 ≤:20	C ___
	30	0 1 2 ≤:20	F ___
	31	0 1 2 ≤:25	B ___
	32	0 1 2 ≤:30	A ___
	33	0 1 2 ≤:45	E ___
	34	0 1 2 ≤:45	C ___
	35	0 1 2 ≤:45	D ___
	36	0 1 2 ≤:45	A ___

Ages 5–6
(or ages 7–18 without time points)

☐ Raw Score include items before basal (max. = 36)

Ages 7–18

☐ Raw Score include items before basal (max. = 63)

16. Hand Movements

4 5 6 7–12 13–18

Discontinue: 3 consecutive scores of 0

Symbols: S = side, P = palm, F = fist

Item	Score	Response
All ▶ S		P—P
1	0 1	F—F
2	0 1	S—F
3	0 1	F—S
4	0 1	P—S
5	0 1	P—F
6	0 1	S—F—S
7	0 1	P—S—P
8	0 1	S—F—F—S
9	0 1	F—S—S—P
10	0 1	P—F—S
11	0 1	F—P—F—P
12	0 1	S—P—S—F
13	0 1	S—P—S—P—S
14	0 1	F—S—F—S—P
15	0 1	P—S—F—P
16	0 1	P—F—S—F
17	0 1	S—P—F—S—P
18	0 1	P—S—S—P—F—F
19	0 1	P—S—P—F—S
20	0 1	F—P—F—S—P
21	0 1	F—S—P—S—S—P
22	0 1	P—F—S—P—S—F
23	0 1	P—F—P—S—S—F—P

___ Ceiling Item

___ minus errors

☐ Raw Score (max. = 23)

QIs (optional) *Pattern Reasoning*

− Fails to sustain attention
− Impulsively responds incorrectly
+ Perseveres
− Reluctant to respond when uncertain
+ Tries to solve problem before looking at options

QIs (optional) *Hand Movements*

− Fails to sustain attention
− Hesitates over which hand to use
+ Unusually focused
+ Verbalizes a strategy

Appendix 6: GAD-7 Questionnaire

GAD-7 Anxiety

Over the last two weeks, how often have you been bothered by the following problems?	Not at all	Several days	More than half the days	Nearly every day
1. Feeling nervous, anxious, or on edge	0	1	2	3
2. Not being able to stop or control worrying	0	1	2	3
3. Worrying too much about different things	0	1	2	3
4. Trouble relaxing	0	1	2	3
5. Being so restless that it is hard to sit still	0	1	2	3
6. Becoming easily annoyed or irritable	0	1	2	3
7. Feeling afraid, as if something awful might happen	0	1	2	3

Column totals _____ + _____ + _____ + _____ =

Total score _____

If you checked any problems, how difficult have they made it for you to do your work, take care of things at home, or get along with other people?

Not difficult at all	Somewhat difficult	Very difficult	Extremely difficult
☐	☐	☐	☐

Source: Primary Care Evaluation of Mental Disorders Patient Health Questionnaire (PRIME-MD-PHQ). The PHQ was developed by Drs. Robert L. Spitzer, Janet B.W. Williams, Kurt Kroenke, and colleagues. For research information, contact Dr. Spitzer at ris8@columbia.edu. PRIME-MD® is a trademark of Pfizer Inc. Copyright© 1999 Pfizer Inc. All rights reserved. Reproduced with permission

Scoring GAD-7 Anxiety Severity

This is calculated by assigning scores of 0, 1, 2, and 3 to the response categories, respectively, of "not at all," "several days," "more than half the days," and "nearly every day."
GAD-7 total score for the seven items ranges from 0 to 21.

0–4: minimal anxiety

5–9: mild anxiety

10–14: moderate anxiety

15–21: severe anxiety