Applying Generalisability Theory to Examine the Distinction Between State and Trait in the State and Trait Anxiety Inventory (STAI).

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Abstract

Accurate distinction between state and trait anxiety is necessary for monitoring of individual anxiety levels over time and developing effective interventions to reduce anxiety, which is especially important in the current COVID-19 pandemic situation increasing anxiety of the world population. The widely used State and Trait Anxiety Inventory (STAI) with 78,600 Google scholar citations to date, was specifically designed to measure both state and trait anxiety. However, ability of the STAI to accurately distinguish between the two and the overall reliability and generalisability of its assessment scores were not rigorously investigated using appropriate methodology. Generalisability theory (G-theory) is increasingly used as the most robust method to distinguish between state and trait and establish the overall reliability while accounting for specific error sources in the assessment of psychological conditions.

G-theory was applied to the 40-item STAI completed by 139 participants on three occasions separated by two-week intervals. Both subscales of the STAI demonstrated excellent reliability in measuring trait anxiety with high generalizability of scores across occasions (G=0.84-0.92) but fail to distinguish state from trait. This means that the state subscale of the STAI is not suitable to detect changes over time and reliably measure state anxiety. A minor amount of error variance identified in the STAI subscales were mainly attributed to interaction between person and occasion, which reflected state anxiety, and interaction between person, item and occasion. Dynamic aspects of anxiety were identified in both subscales including feelings of satisfaction, nervousness, feeling pleasant, restlessness, perceived failure, lack of calmness, feeling insecure, feeling inadequate and sensitivity to disappointments. This study derived a sensitive state anxiety scale using G-theory that includes items the most sensitive to state changes. State anxiety can be measured with higher accuracy by using the proposed short state scale without modifications of the original STAI format. Dynamic aspects of anxiety identified using G-theory, are more amendable, and proposed as the primary target of interventions aiming at effectively reducing anxiety. Further enhancement of state anxiety measurement informed by G- theory is warranted. Overall, this study contributed to enhanced assessment of state and trait anxiety and informs psychological interventions aiming at more effective reduction of anxiety.

Keywords: Generalisability Theory, State & Trait, Anxiety, State and Trait Anxiety Inventory, Reliability

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Chapter 1 Anxiety

Defining Anxiety

Anxiety is a major mental health concern prevalent in the 21st Century. Anxiety is often associated with depression and both are the most commonly diagnosed mental health disorders suffered by people in their late teenage years to mid to late 40s (Dean, 2016). Those who suffer from anxiety are two to four times more likely to develop depression and in turn more likely to attempt and have suicidal ideations (Dacey et al., 2016). Anxiety can be defined as a persistent condition in which a person perceives a situation, environment or stimuli to be fear-inducing or threatful. It is a person's response to a source, and how it is responded to, which determines if the experience or situation is anxiety-inducing (Spielberger, 2010; Steimer, 2002; Vitasari et al., 2011).

The experience of anxiety differs for each individual, and someone's level of sensitivity towards a situation or context can be stronger or weaker when compared to others. Therefore, anxiety often has an impact on everyday life and experiences for an individual, depending on the perception of an experience or situation which may be anxiety-inducing (Steimer, 2002; Vitasari et al., 2011). As anxiety can be debilitating, people who experience it will often avoid anxiety-inducing situations which can affect a person's social life and environments. This highlights the need and purpose of the research to be more readily able to identify and distinguish between state and trait anxiety, and what it stems from, so it can be diagnosed accurately, and treatment plans developed.

Where state anxiety is dynamic over time and manifests itself when an individual perceives an environment or situation to be threatening or fearful (Starlet, 2013). Trait anxiety is enduring over time and having high levels of trait anxiety can make an individual more likely to perceive situations as anxiety-inducing and can lead to the development of a disorder (Gidron, 2013; Horikawa & Yagi, 2012). An importance is placed on the significance of accurate assessment for state and trait anxiety to assess efficiency of anxiety interventions, treatments and diagnosis (Medvedev et al., 2017). Thus, a differentiation between state and trait anxiety needs to be made as state anxiety can be experienced by all, it is trait anxiety that becomes a problem when it is enduring.

Evolutionary Role of Anxiety

A moderate amount of fear around events, environments, crisis or stimuli, can motivate individuals to not let experiences takeover or ruin factors of life and motivate them towards change or learning about them. For example, when faced with epidemic or pandemic of the spreading of infectious viruses, such as COVID-19, the anxiety around this makes people act (Ministry of Health, 2020). This can be done by, implementing travel restrictions, going into lockdown, being more conscious of personal hygiene, wearing masks when out in public and quarantining those who may have been exposed to the virus. If there was no anxiety about the spread of the virus and no level of fear of the effects and consequences it will have on the population, people would not be worried about it which could lead to increased mortality and burden of diseases and viruses. Whereas, when there is a fear factor around this virus, strategies can be implemented and developed to stop the spread of viral infections. This is done to try and stop the spread of the virus because there is some level of anxiety around it and its potential effects. When this type of anxiety is demonstrated, it is mostly state anxiety and shows how the fight or flight response is engaged through anxiety (Griswold, 2018).

Fight or Flight Response

Biology, stress and genetics, all interact to produce the effect of anxiety on the body and brain. When multiple factors are present due to an individual’s genetics and their environment, what is considered by an individual a fearful or threatening situation causes the body to engage its fight or flight response. When the fight or flight response (anxiety) system is activated, it gives the body more blood flow where it is needed such as, the arms, legs, muscles and brain. This gives them extra energy and activates the senses so a person can be hyper aware of the ‘danger’ around them and be ready to escape (flight) or fight (Griswold, 2018). This is the body's first functional response to a stressful, threatening or fearful situation, and it allows the body to decide on how to react and respond to an event or stimuli when it is activated (Ghinassi, 2010). When the body overreacts or the feelings of fear persist and there is an abnormal response to an event or stimuli, this reaction of the body is now identified as anxiety (Bystritsky et al., 2013). Several researchers state it is not anxiety and the body's response mechanisms (fight or flight) to anxiety that is the problem. The problem is when an anxiety disorder is present while there is no actual threat, and the fight or flight system in the body is malfunctioning (Griswold, 2018; Wheatley, 1998).

It is suggested that a condition for anxiety is the body's inherited genes for it, which influences the core processes that are activated due to stress reactivity (Lau et al., 2006a). This experience of anxiety through the fight or flight response by a person, is due in part to its role in helping the survival of a race. Anxiety has evolutionary advantages in the way it can be used as a survival mechanism, as it induces the fight or flight response in humans. Therefore, it is not unusual to experience state anxiety, as this is experienced by everyone and is considered a natural experience. Issues become apparent when high levels of trait anxiety are continually experienced. Thus, the importance of the distinction between state and trait anxiety needs to be clear, so accurate diagnosis can be made.

Autonomic Nervous System

The autonomic nervous system's response to stress and anxiety on the body involves activation of the two branches of the autonomic nervous system, the sympathetic nervous system and the parasympathetic nervous system (Kushki et al., 2013). The autonomic nervous system is active 24/7 and it is responsible for all involuntary processes of the body, such as breathing, heart rate, pupillary response, regulatory processes and bodily functions. The two branches within this system work against each other as the sympathetic nervous system is activated first and it releases two chemicals in the body, adrenalin and noradrenalin. These chemicals are released from the kidney's adrenal glands, which send the messages from the sympathetic nervous system to keep the activity in the body going, which are the physical symptoms of anxiety (Barlow, 2002; Spielberger, 2010; Wheatley, 1998).

The parasympathetic nervous system then becomes activated to help oppose and get rid of adrenalin and noradrenalin chemicals in the body, which helps to produce a relaxed feeling and restore the body to its natural state. For example, when an anxiety attack activates the sympathetic nervous system, the parasympathetic nervous system eventually gets activated to counteract the impact the sympathetic nervous system has on the body. Thus, reverting the body back to its normal state once the anxiety-inducing experience is over (Kushki et al., 2013). An anxiety attack may appear to last a long time by feelings of apprehension or being on edge for a while after an episode. This is due to the chemicals in the body still dissipating for a time once the episode is over. The physical symptoms of anxiety, activation of the body's fight or flight response, the autonomic nervous system, the sympathetic nervous system, the parasympathetic nervous system and neuroendocrine activation, are all outcomes and physical responses of anxiety on a person. It has been researched and suggested, when dealt with correctly by the human brain and body, that anxiety is an advantage and essential to survival (Kunimatsu & Marsee, 2012). Hence, if due to high levels of trait anxiety, the body's autonomic nervous system is constantly reacting to perceived anxiety-inducing experiences, it becomes hard to distinguish between what experiences are truly a result of state or trait anxiety.

Furthermore, it is often cited that the experience of anxiety is due to; the experience of a past traumatic event or trauma, it stems from other mental health disorders (stress and depression) and a person is predisposed to it through inherited genetics and environments (Dean, 2016). Thus, anxiety is a combination of negative life events, environments and learning, which as a result can have debilitating effects on everyday life for a person (Ghinassi, 2010). Anxiety in some cases can be considered a comorbid mental health disorder, the presence of additional disorders, such as stress and depression, are often seen in someone who presents with anxiety and one can often lead onto or exacerbate the other and vice versa (Rawson et al., 1994). Essentially, if the cause or causes of anxiety are identified, a distinction between state and trait anxiety can be made. This distinction will help develop an understanding of the role anxiety has in a person's life, so the effects of anxiety can be fully understood and aid in diagnoses and treatment.

Anxiety Disorders and Diagnostic Criteria

According to the American Psychological Association (2019) anxiety is one of the most frequently diagnosed psychiatric disorders. Anxiety is a state induced in humans when they feel threatened, nervous or fearful of an actual situation or a potential one. Those who experience anxiety, present with physical symptoms which are related to a psychological condition; thus, it has both psychological and physiological behavioural components (Spratt, 2014; Steimer, 2002). Furthermore, in the past it has commonly been questioned whether anxiety disorders stem from the age-old argument of nature vs nurture. This is done by comparing a person's environment vs genes and deciding whether one predisposes an individual to anxiety or not. Anxiety has often been conceptualised into two distinct subscales, which are defined as either state or trait anxiety. State anxiety is the environment, situations or stimulus which exist and are considered to be threatening, dangerous or something to be fearful of (De Visser et al., 2010). Where, trait anxiety is the characteristics of a person which causes them to perceive different environments, situations or stimuli as threatening, dangerous or fearful, as a result of a predisposition to have these traits through a mix of genetics, brain chemistry, life experiences and personality (Bystritsky et al., 2013).

In recent years researchers suggest anxiety stems from a combination of three factors interacting together, biological, social and psychological, in psychology this is often referred to as the 'biopsychosocial model' (Dacey et al., 2016). After investigation of the different types of anxiety disorders there is no specific criteria for any form of disorder, but they all have common features and characteristics that can help indicate towards and determine a diagnosis of some form of an anxiety disorder. Any form of anxiety disorder is mainly characterised by the following, a genetic predisposition to being more likely to suffer from anxiety than others (biological), being more prevalent in females than males, with the onset for most anxiety disorders presenting themselves by late adolescents. Anxiety disorders are also largely characterised by intense feelings of panic, worry or fear, when an individual perceives a situation, environment or stimulus to be fearful (psychological). Anxiety disorders are also portrayed by often having negative impacts on a person's everyday life, as a person often ends up with an impaired ability to function in social settings due to the embarrassment of suffering an episode of anxiety when in public. This in turn often causes the person to implement avoidance behaviour's towards normal everyday social settings and experiences as a coping strategy (Dacey et al., 2016; Vitasari et al., 2011). It is important to identify whether the anxiety that is occurring is a result of state or trait anxiety, as state anxiety is common and goes away, whereas high levels of trait anxiety, because it is persistent, requires a diagnosis and treatment.

Diagnostic Criteria

Anxiety disorders are categorised into different types, which are listed below, as outlined from the Diagnostic and Statistical Manual of Mental Disorders IV (DSM-IV). This includes but is not limited to, panic disorders, social phobia, specific phobias and post-traumatic stress disorder (PTSD), acute stress disorder, obsessive compulsive disorder, and generalised anxiety disorder (GAD) (DSM-5 American Psychiatric Association, 2013). The diagnostic criteria for anxiety, according to the DSM-IV, states that a person must present with the following conditions: excessive anxiety and worry for more days than not, for at least six months, find it difficult to control the worry, have three or more of the six anxiety symptoms (restlessness, fatigue, difficulty concentrating, irritability, muscle tension, sleep disturbance) for more days than not in the last six months. The following must also be present: the focus of the anxiety is not confined to features of an Axis I disorder, the anxiety or symptoms cause significant distress or impairment in the functioning of daily life and the anxiety and its symptoms are not caused by the direct physiological effects of a substance (e.g. drugs) (Barton et al., 2014; Bystritsky et al., 2013).

Panic Disorder

Panic disorder can include agoraphobia or be without, it affects 2.5% of people at some stage in their lives and is one form of anxiety where the person experiences unexpected, constant and reoccurring panic attacks (Craske & Stein, 2016). The attacks are sudden, unforeseen and are characterised by extreme feelings of fear and panic, irregular heartbeat, shaking, sweating and shortness of breath (American Psychiatric Association, 2013). The attack duration is short lived but reaches its uttermost point in minutes. The attack is usually triggered by what is perceived by the individual to be a fearful or threatening situation, object or environment and will often adapt maladaptive avoidance behaviour's to avoid these scenarios in the future (McNally, 2002).

Panic disorders occur when a person has an intense fear of a combination of two or more situations. Situations can include use of public transport, crowds or public spaces, open and enclosed spaces and being outside of the home (Craske & Barlow, 2008). A person will have a fear of these situations or similar ones, because of the fear of embarrassment of a panic attack occurring and being unable to remove themselves from the situation (American Psychiatric Association, 2013; Craske & Barlow, 2008). The onset and cause of the development of a panic disorder is unclear but it is often suggested that it has an inheritability factor. It is diagnosed in women more than men and the onset of panic disorders are most commonly developed and diagnosed in adolescents and young adults (American Psychiatric Association, 2013).

Social Phobia

Social phobia, also referred to as social anxiety, affects about 7% of the population at any given time. A form of anxiety where a person experiences a fear of social situations where they must engage and interact with others (Stein & Stein, 2008). Onset is usually from early adolescents into adulthood and is often suggested by researchers that it may be partly inherited and due to a person's brain structure (Stein & Stein, 2008). This fear can cause the person to have an impaired ability to function in social settings and can affect almost all areas of life, as a person will often actively try to avoid situations and settings that will exacerbate the social phobia. It is this impaired ability to function which can cause them much distress, hence, the social phobia disorder is commonly brought on by a fear of negative scrutiny and evaluation from others (Leary & Kowalski, 1997). Social phobia symptoms can include panic attacks, blushing, increased heart rate, shaking, nausea and sweating.

Specific Phobias

Specific phobias affect 12% of the population at some point in their lives and is one form of anxiety where a person exhibits an irrational fear over exposure to or anticipation of being exposed to specific objects, events or situations (Craske & Stein, 2016). Specific phobia encompasses a range of events and stimuli, such as a fear of flying or heights and objects such as spiders and seeing blood. Symptoms of specific phobia include showing excessive amounts of fear or discomfort when presented with the stimuli or event of which they are phobic (Antony & Barlow, 1998). This can sometimes result in a panic attack, shortness of breath, increased heart rate, sweating and trembling. Most cases of specific phobia become apparent in late childhood to early adolescents and are more common in women than men (Craske & Stein, 2016).

Post-Traumatic Stress Disorder (PTSD)

PTSD affects about 9% of the population at some point in their lives and 3.5% of adults in any given year (American Psychiatric Association, 2013). A form of anxiety that typically presents itself after a person has been exposed to or experienced a traumatic event. PTSD usually lasts for at least a month after the event or trauma and can include, disturbed thoughts and feelings about the event, mental and physical distress and a change in a person's mood. The American Psychiatric Association (2013) states that how a person might think and feel can cause an increase in a person's flight and fight response mechanism in the body, which can often cause them to overreact to situations after they have experienced a traumatic event. This disorder is more prevalent in women than in men and someone who suffers from this disorder is at a higher risk for suicide and intentional self-harm (Bisson et al., 2015; Charnsil & Chailangkarn, 2020).

Acute Stress Disorder

Acute stress disorder is present in about 10-30% of people who have experienced a traumatic event and is a form of anxiety that is brought on after a traumatic experience has occurred (Reynaud et al., 2015). This disorder is often closely linked to PTSD and is thought that acute stress disorder often develops and leads into PTSD, when the duration of stressful episodes is ongoing (Harvey & Bryant, 1998). Acute stress disorder can be brought on by witnessing events or being involved in them, such as a car crash, being told bad news or experiencing sexual assault. It is characterised by repeated nightmares or memories of an event, dissociation in memory, lack of sleep, difficult to control breathing and nausea (Bryant & Harvey, 2000). Like most anxiety disorders, where one person may suffer an acute stress disorder after experiencing or witnessing a traumatic event, others may not.

Obsessive-Compulsive Disorder

Obsessive compulsive disorder affects between 2-3% of people at some time in their lives. A form of anxiety that involves a person performing certain routines and patterns compulsively or has repeated thoughts obsessively, of which the person can only control for a short period of time, before feeling a desperate need to act on them (Goodman et al., 2014). The exact cause of obsessive-compulsive disorder is unknown, but suggestions have been made that it is a malfunction in the brain to stop intrusive thoughts and the inability to not respond to actions (Abramowitz et al., 2009). It usually develops before the age of 20 and not after 35, with males and females equally represented. Symptoms often include excessive washing of hands, obsessive actions of checking things have been done properly and having unusual images in the mind, which can be cause for unrealistic fears and disrupt the functioning of one's daily life and activities (DSM-5 American Psychiatric Association, 2013).

Generalised Anxiety Disorder (GAD)

GAD affects about 2% of people each year and 4% of people are affected at some point in their lives (Craske & Stein, 2016). It is a form of anxiety where a person experiences excessive or extreme, irrational and uncontrollable worry and fear about events, situations or objects (DSM-5 American Psychiatric Association, 2013). Symptoms persist for at least six months for a diagnosis to be made and can include, sweating, trembling, irritability, excessive worry and fear and lack of sleep (Craske & Stein, 2016; DSM-5 American Psychiatric Association, 2013). GAD usually develops in response to a life stressor or traumatic experience and is twice as common in women than men, with a third of variance in GAD being attributed to genes (Hettema et al., 2001).

Individuals who have a genetic predisposition to GAD are more likely to develop the disorder in response to stressful or traumatic life events.

Anxiety Symptoms

Characteristics of anxiety include but are not limited to, feelings of expectancy, autonomic and neuroendocrine activation and specific behaviour patterns which include avoidance, fearfulness and erratic behaviour (Steimer, 2002). Some of these symptoms manifest themselves internally, whilst others can be external bodily reactions which may be apparent to other people. Anxiety symptoms can disturb the normal psychological or physiological functioning of a person. As anxiety presents and manifests itself both psychologically and physically, it is often considered a psychophysiological disorder (Cuthbert et al., 2003)**.** Some psychological symptoms of anxiety manifest itself in some of the following ways, feelings of worry, fatigue, irritability, feeling on edge and getting upset easily. Whereas the physical symptoms of anxiety through the activation of the autonomic nervous system in the body presents as: sweating profusely, increased heart rate, shaking, muscle tension, lighthearted, shortness of breath, nausea and gastrointestinal issues (Dean, 2016). These are some of the physical symptoms of anxiety and is what leads medical practitioners to believe that it is the sympathetic nervous system that is activated during this anxiety response through cognitive and emotional states (Friedman & Thayer, 1998; Jarrett et al., 2003).

The psychological and physical symptoms of anxiety have a corresponding relationship where one can affect and cause the other, which is why anxiety is often considered a psychophysiological disorder (Lang, 1985)**.** Psychological symptoms of anxiety are more related to trait anxiety while the physical symptoms of anxiety are reflecting more state anxiety than trait anxiety. Therefore, it is significant to the state-trait distinction to accurately measure both psychological and physical symptoms of anxiety to help make a clear distinction between whether anxiety is stemming from state or trait factors.

Biological and Psychological Aspects of Anxiety

Interaction Between Physical and Psychological Symptoms

Sansone (2010) summarises that a physical disorder which has psychological overlays is a psychophysiological disorder. Combining psychological and physiological practices became apparent in the mid 90's, where psychologists looked at the interaction between the mind and the body and how both factors affect each other (Stern et al., 2000). The meaning of the word 'psychophysiological' coined with disorders in the early days used to focus on how physical symptoms are often dependent on psychological conditions. Yet, in more recent times psychophysiologist's continue to expand on its meaning and recognise that equally changes to physiology can be cause for behavioural changes for someone who suffers from a psychophysiological disorder (Stern et al., 2000). There are many psychophysiological conditions to consider when researching at anxiety and the reasons for these conditions or the appearance of symptoms, so anxiety can be more accurately identified and treated.

The biological and psychological aspect of anxiety can have physical effects on a person who suffers from anxiety, therefore, the psychological condition can exacerbate the physical symptoms, depending on the intensity of the disorder or condition. In turn, the physical symptoms can have a reciprocal effect where it heightens the recurrence of the condition for fear or anxiousness around how the condition will present itself physically (Cuthbert et al., 2003). Thus, when psychological and physiological variables interact to produce a pathological state, it can be concluded that it is a psychophysiological disorder (Williamson et al., 1994).

Physical symptoms of an anxiety disorder can be made worse or be caused by psychological problems, the two go hand in hand. Psychophysiological disorders can be separated into two categories, where the physical factor contributes to the psychological symptoms and where the psychological factor contributes to the physical symptoms, also known as a somatoform disorder. A somatoform disorder is where a psychological disorder presents itself with physical symptoms and there is no underlying medical or neurological condition to explain them (Spratt, 2014). A somatoform disorder could be exhibited in someone who suffers from depression over the death of a family member and now presents with paralysis in one arm and there is found to be no physical or medical reason for this. The paralysis has no physiological cause, but it is the psychological pain that is causing the paralysis (Spratt, 2014). The other psychophysiological disorder is when the physical symptoms are caused by a physical condition but are exacerbated or made worse due to a psychological condition (Cuthbert et al., 2003; Spratt, 2014). For example, when someone has a family history of and experiences high blood pressure, and if pressure from a job is felt, this pressure and stress and the psychological condition, make the physical condition of high blood pressure worse.

Numerous studies have been developed to investigate the relationship between psychological conditions and physical components of a disorder. A study conducted by Hemingway and Marmot (1999) investigated how psychological factors may contribute and increase factors that lead, and cause health problems related to cardiovascular diseases, looking closely at coronary heart disease. The study found that psychological disorders of anxiety and depression are contributing risk factors in cardiovascular morbidity and mortality (Hemingway & Marmot, 1999; Kopp & Rethelyi, 2004). It was summarised that negative emotions can be associated with poor health. A similar study by Kubzansky and Kawachi (2000) found that out of a variety of emotions, anxiety had the strongest evidence for contributing to a decline in physical health for a person. These studies show the interlinked relationship between the body's psychology and physical dimensions, as it reflects how the psychological nature of mental health issues and disorders can contribute to and exacerbate physical health issues and vice versa.

Therefore, there are many types of psychophysiological disorders and there is an importance to acknowledge and identify behavioural problems which come with physiological components, such as anxiety and depression (Haynes, 1998). With specific reference to all disorders that fall under the anxiety umbrella as outlined in the DSM-IV, when categorising anxiety as a psychophysiological disorder, it is looked at from the perception that it affects both aspects of a person (Bystritsky et al., 2013; DSM-5 American Psychiatric Association, 2013). Where the psychological aspect of anxiety can cause the physical symptoms of anxiety to present themselves. Yet, there is no physical reason for these physical symptoms to present themselves apart from the psychological fear of a situation - anxiety (somatoform disorder). Anxiety can also exacerbate and enhance physical symptoms that are pre-existing, such as heightened blood pressure, which is why it is important to understand the psychological bases of anxiety. If understanding it can help determine and understand if the anxiety is state or trait, it can be more clearly understood how to diagnose and treat the anxiety more accurately.

Anxiety, Stress, Depression and Fear

It has often been thought and identified by researchers such as Bystritsky et al. (2013) and Rawson et al. (1994), that anxiety goes hand in hand with conditions of depression and stress, and these conditions and factors need to be present for anxiety to occur. Many studies show and investigate the correlation and interconnected relationship between anxiety, stress and depression. Stress and depression are described as pathological, where it involves or is caused by a physical or mental disorder and so can be caused by anxiety and cause anxiety (Gray et al., 2014). Stress can impact anxiety, as stress can often be adaptive and healthy, stress can also be a trigger for anxiety. The effects of stress are usually short-lived, where anxiety is a sustained mental health disorder which is a long-term condition. However, as stress and anxiety have overlapping physiological factors, the more a person experiences a stressful situation the more the physical symptoms of stress start to look like anxiety symptoms, if they endure over time. Therefore, this stress, when it becomes a constant and recurring state of behaviour and can no longer be classified as short-lived, can have an influence on a person's anxiety (Bystritsky et al., 2013).

Bystritsky et al. (2013) makes notes on the significant role of stress in aiding and inducing an anxiety disorder. It was stated that stress is largely responsible for the causes and effects of anxiety disorders and for some anxiety disorders, such as PTSD, stress is the main etiological factor and condition causing this disorder (Bystritsky et al., 2013). The study investigated current diagnosis and treatments of anxiety disorders. The diagnoses were looked at both dimensionally and structurally. Bystritsky et al. (2013) found that treatment for anxiety disorders can be done through both psychopharmacological and cognitive-behavioural interventions. A dimensional diagnosis in terms of anxiety, refers to a continuum where an individual can have varying levels of a characteristic. A structural or categorical diagnosis is where a practitioner decides based on symptoms and characteristics of an individual, whether a disorder is present or not, depending on the types of symptoms, characteristics and conditions related to said disorder (Brown & Barlow, 2005; Potuzak, et al., 2012). In Bystritsky et al.'s (2013) study it was stated that individuals who suffer from an anxiety disorder can often recognise the onset of the anxiety to a particular stressful event or experience in the past. This 'stressor' can also be a continuous and recurring event or episode in a person's life.

Anxiety disorders are also often marked by fear that is more than an average person would experience in each situation (Shin & Liberzon, 2010). The condition of fear for anxiety is both a physiological and emotional response that occurs due to being exposed to a stressful stimulus, the stressful stimuli cause changes in the body's metabolic and organ functions (Öhman, (2000). When the body's fear response is activated, changes to the metabolic and organ functions can include but are not limited to, increased heart rate, muscle tension, alertness and sweating (Davis, 1997). It is important to note that symptoms of fear are not dissimilar to the symptoms and physiological reactions of anxiety and its fight or flight response system. During an anxiety attack, the fear will be in response to certain environments, social settings and specific objects which trigger the bodies 'fear' response. This response is usually a reaction to stimuli or situations that are absent of any real danger or threatening situations.

Rawson et al. (1994) explored the interrelationships between the conditions of stress, depression, anxiety and physical illness in college students, using a proportional sample of 184 college undergraduates. It was found that significant relationships existed between all three factors, stress, depression and anxiety with illness, and that more specifically there was also a relationship between anxiety and depression (Rawson et al., 1994). The research also states that there is an undeniable relationship between stress and anxiety and claims that whilst stress can have an extreme effect on an individual's physical health, it is anxiety that acts as the intervening variable for this relationship (Rawson et al., 1994). When exploring depression and anxiety it was acknowledged that the two disorders have overlapping symptoms and that anxiety can lead to depression, and depression to anxiety.

For instance, if a fear of social situations is present, a person will choose to avoid those settings, which can lead to feelings of loneliness and thus triggering depression-like symptoms. In addition to stress and depression, further studies completed on anxiety, address the factor of fear as a psychological condition that is present during and contributes to an anxiety disorder. Thus, it is important to make the distinction between if state or trait anxiety is being experienced, so if it is trait anxiety, the cause of it, which could stem from stress, fear or depression, can be identified, and then appropriate diagnosis and treatment plans developed. Whereas, if it is state anxiety, and the anxiety goes away once the anxiety-inducing stimulus is removed, it does not need to be investigated as state anxiety is part of normal life experiences. It only becomes a problem when the anxiety becomes enduring over time.

Anxiety and the Brain

Most individuals when exposed to stressful events recover from the situation and without developing a mental health disorder. However, for individuals where anxiety is caused by stress it is suggested that the brain has a loss of resilience and it gets short circuited into a maladaptive state where it cannot return to its normal balance and level of normal functioning (Gray et al., 2014). These stressful experiences or events can sensitize an individual to other stressful stimuli where the person will continue to experience heightened levels of stress when exposed to other stressful events.

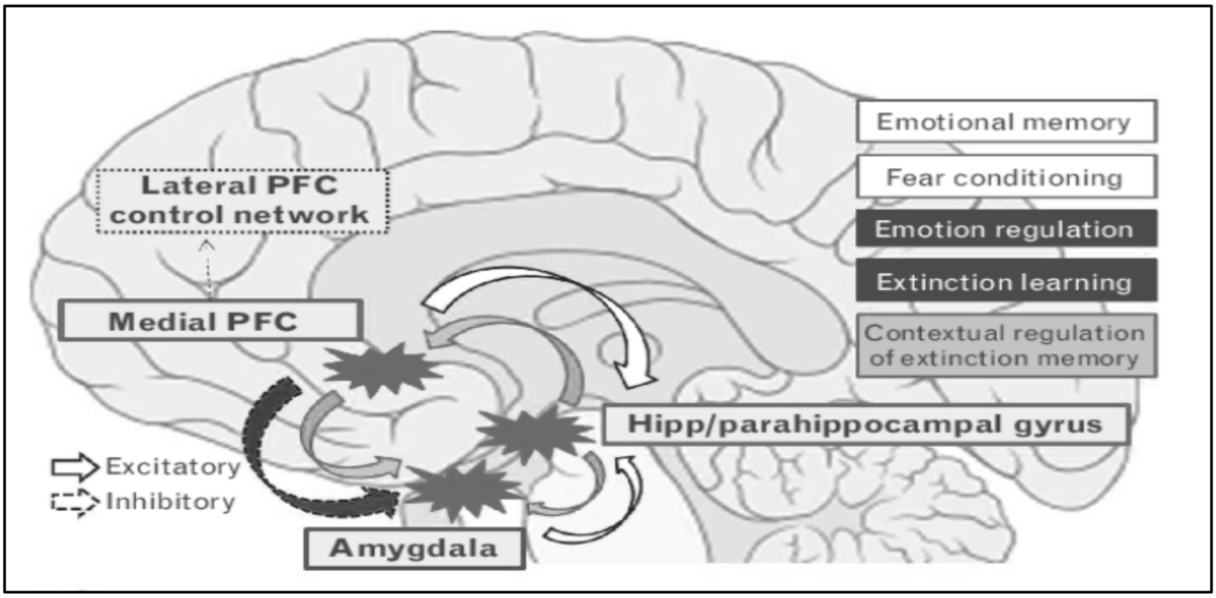
Anxiety, which can stem from a person's reaction to stress, can induce changes in the brain pathways as the hippocampus part of the brain is highly sensitive to the effects of stress which can become anxiety-inducing (Maron & Nutt, 2017). These changes are a result of gene expression and can occur quickly after exposure to a stressful experience, they can be short lived or endure after the stressful experience is over (Gray et al., 2014). Chronic enduring stress impairs the hippocampus depending on the intensity, duration and frequency of the stress. Chronic stress has been linked to structural degeneration and impaired functioning of the hippocampus and the prefrontal cortex in the brain, making it more likely for anxiety to occur. These damaged parts of the brain can cause the development of disorders such as depression and anxiety because of the impaired functioning on the brain due to chronic stress.

The amygdala is the part of the human brain that is responsible for the 'fear response' as it deciphers the emotional salience of stimuli (Davis, 1997). The body is usually overwhelmed by the fear-inducing stimuli and processes it in excessive detail, and the stimuli is categorised into either something to be feared or not. This means a 'worst case scenario' is often adapted and then the body engages and acts to protect itself against the perceived threat, which can be reflected as anxiety when the condition of fear is met (Bystritsky et al., 2013). Shin and Liberzon's (2010) research reviewed numerous studies on the neurocircuitry of anxiety disorders, including the fear circuits in animal models, the study of brain circuits to emotional PTSD, and social phobia and specific phobia when exposed to disorder relevant stimuli. It was found that all of these create a relatively heightened amount of activity in the amygdala, which is activated in response to the stimuli (Shin & Liberzon, 2010).

The key structures in the neurocircuitry of fear and anxiety are modelled in Figure 1, which includes the amygdala, medial prefrontal cortex and the hippocampus, which are parts of the brain most affected and impacted during exposure to chronic stress (Mah et al., 2015). These parts of the brain are responsible for emotional regulation, the mediation of fear conditioning and extinction, and to regulate the stress response. Therefore, when these pathways become damaged through stress, the amygdala tends to become overactive whilst the prefrontal cortex becomes underactive (Mah et al., 2015). Thus, if anxiety goes untreated or is avoided, a malicious cycle can start to develop, where anxiety causes or increases the likelihood of other mental disorders co-existing with anxiety for individuals over time (Eisenberg et al., 2007).

Figure 1

Key Brain Structures in the Neurocircuitry of Emotion Regulation Impacted by Stress. Adopted from Mah et al., (2015).



Biological and Psychological Factors

Researchers such as Jacofsky et al. (2020) and Maron and Nutt (2017), suggest that if a person is already biologically predisposed to anxiety, combined with a psychological vulnerability to developing the disorder, an anxiety disorder is more likely to develop. Conditions for developing psychological vulnerabilities to developing anxiety include, traumatic or stressful early life experiences and a lack of perceived control over stress-inducing circumstances (Barlow, 2002). Barlow (2002) who explored the domain of the nature and treatment of anxiety and panic disorders, summarised that anxiety is partly as a result of biological functions, and more specifically, an individual's perceived ability to control a stimuli or stressful event. When some of these conditions are met anxiety can present itself. The perceived lack of control may not be accurate according to the situation or stimuli, but the anxiety stems from how in control a person may feel depending on their biological factors (Barlow, 2002).

Genetics also has its role to play in why a person experiences anxiety. Strong evidence suggests anxiety is caused in part by an inherited gene that makes some individuals more predisposed to having anxious episodes and presenting with anxiety. The role of behavioural epigenetics in anxiety supports the notion that anxiety can be a learnt behaviour passed on through genetics. Behavioural epigenetics refers to the heritable phenotype changes of a gene that do not affect the DNA sequence (Berger et al., 2009**).** In layman's terms this means that there is reason to believe that a person inherits learnt behaviours through genes via epigenetic mechanisms. The inherited factor of anxiety explores how nurture shapes an individual's nature and how genes are influenced by experiences and environments which are passed down through generations (Powledge, 2011). For example, someone who experiences high levels of stress and anxiety in large crowds or in small spaces, are likely to pass on these traits to their offspring through epigenetics and biological inheritance of past learnt behaviours.

Biological and genetic factors of anxiety lead researchers to investigate what aspects of anxiety are caused by genetics and a tendency towards certain behaviours such as, an irritable temperament, erratic sleep patterns, hormonal imbalances and abnormal brain activity (Vitasari et al., 2011). When these biological markers are present it can lead to an increase in adrenaline being released into the bloodstream, which activates the physical responses of anxiety (Dacey et al., 2016). Where the psychological factor of anxiety often is relative to how individuals perceive and think about the world, it refers to previous life experiences or stimuli that trigger fearful memories or negative experiences an individual has had in the past. If stemming from genetics a person has a high-wired nervous system, events or stimuli can induce anxiety if a person has had negative experiences with them (Dacey et al., 2016).

In research conducted by Maron and Nutt (2017) they delve into understanding the relationship between anxiety and its biological foundations. Evidence from neuroimaging, genetic and neurochemical measurements were reviewed, to understand the potential biomarkers involved in the occurrence, foundations and treatment of anxiety. Biological factors often refer to 'biomarkers' for a disorder, in this case anxiety, which means the pathology of a gene or a naturally occurring molecule by which a disorder (anxiety) can be identified (Maron & Nutt, 2017). The study found that anxiety can be categorised by significant anatomical changes in the brain, such as increased gray matter in the amygdala. It was also found that there was also increased grey matter in the right putamen part of the brain in individuals with anxiety, compared to someone with no anxiety (Maron & Nutt, 2017).

The putamen part of the brain forms part of a complex loop that is responsible for the preparation of and aiding in the movement of limbs (Gray et al., 2014; Lang, 1985). With a focus on genetic factors and conditions that can predispose a person to an anxiety disorder, the following genes have been suggested as potential biomarkers for an anxiety disorder, monoamine oxidase A *(MAOA)* and solute carrier family 6 member 4 *(SLC6A4)* (Maron & Nutt, 2017). Along with the inheritance of these genetic conditions and a genetic vulnerability, it can make the likelihood of developing anxiety higher. Some studies also point out that if a first degree relative, being someone in the immediate family, suffers from anxiety then it increases the risk of also developing mood and anxiety disorders (Maron & Nutt, 2017).

Overwhelming biological factors to do with a person's gender also dictate whether a person is likely to develop anxiety. Studies show that anxiety and mood disorders are more prevalent among females than males and when females present with anxiety they suffer from more symptoms and experiences than their male counterparts (Meek, 2019; Rawson et al., 1994). Bystritsky et al. (2013) analysed the relationship between the biological aspects and psychological aspects which are related to anxiety and investigated this integrated relationship. It was theorised that the inherited factor for an anxiety disorder could be through the inheritance of abnormal cognition. Where normal cognition is the process of acquiring knowledge and understanding through thoughts, daily experiences and the bodies senses (Oxford Dictionary, 2020).

Cognitive processes use existing knowledge and can generate new knowledge based on things such as experiences, which are analysed from different perspectives and contexts, depending on the individual who is processing the experience (Von Eckardt, 1996). This is how the theory of abnormal cognition is developed around anxiety due to those who suffer from anxiety not processing events, situations or stimuli in the same way that a healthy person who does not suffer from anxiety or mood disorders does. The perception and understanding of an event, situation or stimuli is skewed and where one individual sees a threat or a dangerous and fearful situation, others do not. Thus, it is the cognitive perception and understanding which is abnormal. Bystritsky et al. (2013) suggests that through cognitive theory, there should be an importance placed on the abnormal cognition of a person as an underlying foundation for all anxiety disorders and as a biological factor and cause of anxiety.

Overall, many efforts have been made by psychiatrists and researchers alike, to emphasize the importance and identification of biological conditions and biomarkers that may highlight an anxiety disorder in an individual. Early identification of these biomarkers and biological conditions could contribute significantly to the improvement of diagnosis of anxiety, prevention strategies and treatment for anxiety disorders (Maron & Nutt, 2017). Hence, there is no singular cause or certain conditions that must be met for an anxiety disorder to be present. But a multitude and combination of factors and conditions combined, can increase the chances or exacerbate an individual's onset and development of anxiety.

The experiences of stress, depression and fear, have intertwined and overlapping pathology and etiology from what external stimuli causes stress, depression and fear, and how the physiological and psychological factors of stress, depression and fear present themselves in an individual. These factors all have shared properties with anxiety and it is often found in research that anxiety needs to be combined with one or more of stress, depression and fear, if not all three factors for an individual to suffer from an anxiety disorder (Bystritsky et al., 2013; Rawson et al., 1994). Stress, depression and fear can come and go in a person's day to day life and whether individuals experience either stress, depression or fear, together or separately, can often be a leading factor and condition in the relapse or continuity of an anxiety disorder being present (Bystritsky et al., 2013; Rawson et al., 1994).

Furthermore, biological factors and conditions such as genes and brain chemistry have also proven to be a leading cause in the onset and causation of anxiety disorders. The body reacts uniquely to everyone's different response to anxiety, as the level of anxiety individuals experience in different situations is dependent on the individuals psychological and physical response at the time (Barlow, 2002; Spielberger, 2010). Whilst Spielberger (2010) states that anxiety is an emotion that is felt through feelings, it is these feelings accompanied by physiological arousal that turns anxiety into a psychophysiological disorder. Physiological arousal is reactions that include, heightened heart rate and blood pressure, change in the respiratory system or change in the gastrointestinal system with feelings of stomach cramping or feeling ill (Lench et al., 2011).

Thus, this means that for individuals who have an anxiety disorder, they are less able to cope successfully with life's challenges (Steimer, 2002). Vulnerability to anxiety stems from several things such as a person's predisposition to have personality characteristics that make them more prone to experiencing anxiety when presented with certain situations or environments (trait anxiety). Steimer (2002) states that these predisposing factors are a result of gene-environment interactions during development mixed with life experiences. Moreover, it is essential accurate diagnosis and treatment of anxiety identifies where the anxiety is stemming from. To do this most effectively, a distinction between state and trait anxiety is crucial.

Social and Environmental Aspects of Anxiety

An article by Bystritsky et al. (2013) describes a model of anxiety by dividing anxiety into three separate categories; alarms, beliefs and coping strategies, coined the 'ABC' model of anxiety. The model describes the 'alarms' as the body's emotional sensations or physiological response to a situation, sensation or thought, that an individual perceives to be threatening and causes an anxious reaction. A set of brain circuits is engaged and quickly processes information about the alarm and decides how to respond (Bystritsky et al., 2013). The way the brain decides to respond to the 'alarms' is made based on 'beliefs' that are heavily influenced by previous experience, environments, thoughts and feelings, personal and cultural background, the body's sensory organs and its perceived ability to continue to function socially.

Bystritsky et al. (2013) believes that a person who is suffering from anxiety will perceive threatful or dangerous situations more acutely and with more of a focused attention on the threat and outcome, than individuals who do not suffer from anxiety. A person will largely focus on what aspects of a situation can go wrong, rather than having a more relaxed attitude of just 'going with the flow' (Bystritsky et al., 2013)**.** The 'alarm' and 'beliefs' factor of this model is largely influenced by how an individual reacts to and interacts with the environment they are in and how the aspect of environments can have an effect and exacerbate a person's anxiety levels. The onset of anxiety in certain environments, influences what type of environments and social settings a person will put themselves in, in the future.

The last part of the 'ABC' model of anxiety looks at coping strategies that an individual can implement to reduce the effects of anxiety during a stressful or threatening situation. It is essential that effective coping strategies for combatting anxiety are explored. Cognitive processes that are learnt and implemented early in life, can be fundamental to helping decrease the development and exacerbation of anxiety disorders. Anxiety can detrimentally affect a person’s social life due to induced anxiety in these settings and being unable to function socially in normal everyday situations (Legerstee et al., 2011). Coping strategies for anxiety refers to specific behaviours, such as a focus on diaphragmatic breathing and mental activity, such as counting to ten. These are aimed at reducing the current anxiety that someone is experiencing and helping to avoid the perceived danger (Bystritsky et al., 2013). Some other behaviour specific coping strategies include avoidance behaviour, where the potential threatening situation is avoided before it has a chance to happen, and mental activity before an event, which includes telling oneself, ‘things will be ok’.

Research on anxiety has found that different coping strategies can be conceptualised into two categories, maladaptive or adaptive, based on how effective they are in reducing anxiety symptoms and preventing the anxiety from taking place (Bystritsky et al., 2013). Maladaptive behaviours are a temporary fix and seen in a more negative light, versus adaptive behaviours and strategies which positively help the person cope with their levels of anxiety. Maladaptive behaviours are considered to reduce one’s level of anxiety but restricts the person's ability to adjust healthily to certain situations that will trigger anxiety, so is just a temporary fix for treating anxiety and not a viable long-term solution (Bystritsky et al., 2013).

For example, avoidance behaviour is a maladaptive coping strategy, by avoiding the situation that may cause anxiety the root cause of the problem is never determined, thus keeping an individual in a destabilised state (Powell & Enright, 2015). This highlights how the social aspect of anxiety can play a major role in being the cause for an anxiety attack, as the social setting can make a person feel anxious. The feelings and symptoms associated with being anxious can cause embarrassment when they present themselves, and the individual will avoid this social situation in the future. Thus, decreasing the ability of a person to function normally and be able to cope with certain social settings. Therefore, adaptive coping strategies, such as experiencing an anxiety-inducing situation repeatedly, will help individuals to develop the skills to adapt and meet the demands of everyday living. The body, in anxiety-inducing environments will eventually learn to adapt and reduce its stress levels, returning it to a state of equilibrium (Bystritsky et al., 2013; Powell & Enright, 2015). Adaptive coping strategies recognise the situation and problem by adopting a problem-solving approach, which has long term benefits in helping reduce the levels of anxiety. Whereas, maladaptive behaviours tend to induce further problems in the future as they do not allow an individual to recognise and understand what is happening around them, and do not develop the techniques and adaptive functions to reduce the recurrence of anxiety (Powell & Enright, 2015).

A predictor of anxiety can be the use of maladaptive coping strategies. Many studies have found that if a person is diagnosed with an anxiety disorder, they will use more maladaptive coping strategies than adaptive coping strategies (Legerstee et al., 2011; Mahmoud et al., 2012). A study conducted by Pozzi et al. (2015) which through a self-report questionnaire, measured the use of both maladaptive and adaptive coping strategies used by participants to cope with problems and stress. Correlations performed in the study suggest that maladaptive coping strategies are also ineffective in coping with anxiety and do not have long term benefits. Whereas, it is suggested again that adaptive coping strategies could be an effective and valid approach to neutralise anxiety and its psychopathology (Pozzi et al., 2015). This in turn shows how social and environmental aspects of anxiety can lead to the implementation of coping strategies, which contribute to the stress process on the body, and can therefore be used as a mediating link between life, environmental or situational stressors and psychological strain (Pozzi et al., 2015).

To conclude, the more understanding there is around the influence a person's social and environmental setting has on anxiety, the better a clinician or practitioner is to suggest treatments for reducing anxiety levels. For those who experience a lot of anxiety due to personality (traits), a clinician can start to effectively identify coping strategies, suggest a reduction in maladaptive coping strategies and steer the person towards implementing more adaptive coping strategies and behaviours. In turn, this will have a positive impact on reducing levels of anxiety (Mahmoud et al., 2012). The social factor of this model which is influenced by the coping aspect, implies that relationships and interactions between people and an individual can exacerbate anxiety. This relationship depends on that person's past experiences in social settings (environments) and if the person is naturally (genetically) wired to feel more tense and agitated in certain settings and environments (Dacey et al., 2016; Dean, 2016).

Overall, in trying to cope with anxiety, individuals will often implement negative coping strategies such as avoidance behaviours, where the individual will avoid certain social situations, environments and settings that are likely to induce and enhance the feelings of anxiety. Unfortunately, this often has a roundabout effect where after implementing avoidance behaviour patterns over a prolonged period, means that the fear around these social settings or environments builds up over time and enhances the anxious feelings further. Individuals may avoid these situations altogether. For social settings and environments, this means that the individual can start to develop intense feelings of loneliness, sadness and neglect, and can lead to depressive episodes or states over time (Bystritsky et al., 2013; Powell & Enright, 2015). Furthermore, whilst it is perfectly acceptable to experience state or trait anxiety due to factors in the environment or socially, too high a levels of trait anxiety induced by these settings is problematic, as it could lead to the onset of an anxiety disorder. Thus, for an accurate diagnosis around coping strategies, a clear distinction for whether the anxiety is state, or trait anxiety needs to be identified, so an accurate diagnosis can be made, and a person treated appropriately so they can learn to cope in all settings. This requires precise measurement of state and trait anxiety using measures well validated using appropriate methodology.

Prevalence of Anxiety

Anxiety in countries such as the United States, United Kingdom, Australia and many other countries show that rates of anxiety have increased up to 10% in the past two decades and is the single highest mental health disorder identified (Dacey et al., 2016; Ghinassi, 2010). Anxiety disorders need to be further investigated so clinicians and practitioners can differentiate between state and trait anxiety, to come up with accurate diagnoses and methods of treatment. The alarming rate of which individuals in the population are diagnosed with an anxiety disorder is a cause for concern, but also the percentage of people who go undiagnosed with an anxiety disorder is an even greater one. The importance of diagnosing and treating anxiety accurately and the research conducted that calls for further knowledge and understanding around an anxiety disorder is compelling.

Anxiety is one of the most prevalent and commonly diagnosed mental health problems worldwide, with specific phobia, social phobia and major depressive disorder being the most commonly diagnosed anxiety disorders (Anxiety and Depression Association of America, 2020). In New Zealand 1 in 4 New Zealanders will be affected by anxiety at some point in their lives (Health Navigator New Zealand, 2020). This is 15% of the population being affected by anxiety at any given time. In the United States there is similar statistics on anxiety, with anxiety affecting 18.1% of the population. Rates of those who receive treatment are low, with only 36.9% of those people suffering from anxiety getting the treatment and diagnosis they need (Anxiety and Depression Association of America, 2020). Worldwide rates of anxiety have been recorded with 12% of people presenting with an anxiety disorder each year, with the World Health Organisation stating this as one in 13 people globally. Along with research conducted on anxiety indicating that 5-30% of these people are affected over their lifetime (Craske & Stein, 2016; Kessler et al., 2007).

Studies and research on anxiety disorders have recorded a higher prevalence of anxiety in certain age groups and with almost twice as many females presenting with anxiety disorders than males (Craske & Stein, 2016). Most mental health problems and anxiety, present themselves between the ages of 15-35 and the rates over these ages are higher than other age groups (Craske & Stein, 2016). Psychological disorders such as depression, stress and anxiety, are all rife in the student population. A report conducted in 2018 showed that psychological disorders were a leading cause for up to 28.4% of students thinking about giving up tertiary studies. This was due to overwhelming feelings relating to their studies, 20.2% because of mental illness and 17.3% because they had a fear of failure (The University of Auckland, 2020). A focus on assessing disorders such as anxiety, depression and stress, amongst the student population could help alleviate the pressures they feel they are faced with. Treatment methods for some of these psychological disorders could be through physical solutions. The report indicated that currently students felt that there were no coping strategies put in place to help them deal with these psychological disorders (The University of Auckland, 2020).

Due to the student population having been highlighted as being riddled with mental health disorders, a student population was determined as particularly suitable to evaluate temporal reliability and validity of the STAI and differentiate between state and trait anxiety. This is due to anxiety levels being higher in a student population because of the competitive and stressful nature of academic work (Bayram & Bilgel, 2008; Eisenberg et al., 2007). Bayram and Bilgel (2008) examined the prevalence of depression, anxiety and stress amongst students, and found that 47.1% of participants presented with anxiety levels of moderate severity and above. The major advantage of focusing on a non-clinical but vulnerable population is a large variability of scores necessary for Generalisability Theory (G-theory) to estimate variance components. Where G-theory is a methodology that helps to distinguish between state and trait anxiety. This is normally lacking in a clinical setting or the general population. Anxiety disorders are generally associated with higher trait anxiety and limited variability of a state making them less suitable to investigate the state-and-trait distinction (Gibbs, 1996). As anxiety can be caused by having a perceived lack of competence to combat a threat or threatful situation, it is prevalent in the student population as they commonly worry over academic performance and pressure to succeed (Beiter et al., 2015; Lazarus, 1991; Regehr et al., 2013). Early detection permits intervention before anxiety becomes a stable and chronic condition of trait anxiety.

Anxiety is highly prevalent amongst students and has proven to be a risk factor leading to the development of other psychiatric disorders, and anxiety disorders are highly associated with substantial impairments in everyday life, including social and academic functioning (Legerstee et al., 2011). In a study conducted by Eisenberg et al. (2007) the prevalence of mental health disorders such as depression, anxiety and suicidal ideation amongst university students and their correlations were examined. Therefore, university students were looked at because there is increasing evidence to support the suggestion that mental health problems are increasing among students who are in institutions of higher education (Eisenberg et al., 2007).

To support this theory, in 2005 a survey undertaken by counselling center directors reported that 86% of directors acknowledged an increase in severe psychological problems amongst the student population (Eisenberg et al., 2007). Eisenberg et al. (2007) implemented the Patient Health Questionnaire to a sample of students who were all 18 years of age or older, with a response rate of 2,843 students. Using the data from this sample of students showed that an estimated prevalence of any depressive or anxiety disorder for undergraduate students was 15.6% and 13% for graduate students. In this study it was reported that those who screened positive for at least one of, major depression, other depression, panic disorder, GAD or suicidal thoughts, 22.4% of these participants also screened positive for at least one or more of these conditions. In particular, the strongest associations for mental health disorders were found to be between GAD and major depression, with 50.1% of students who presented with GAD also presenting with major depression (Eisenberg et al., 2007).

Furthermore, females were twice as likely to screen positive for an anxiety disorder than males, which included panic disorder or GAD. Suicidal ideation in the past 4 weeks was recorded by 2% of students and overall students who report that they are struggling financially have a higher tendency to develop a risk of presenting with mental health problems (Eisenberg et al., 2007). Students who presented with anxiety like symptoms also reported to have lower levels of engagement, lower GPA and suicidal ideation whilst studying. In Eisenberg et al.'s (2007) study it was reported that 18.4% of undergraduate students and 14.1% of graduate students had reported missing academic obligations because of mental health issues and disorders. While, 44.3% of undergraduate students and 41.2% of graduate students reported that academic performance had been affected in some way due to mental or emotional difficulties experienced (Eisenberg et al., 2007).

Eisenberg et al. (2007) suggests a few possible reasons for anxiety being prevalent in the student population which includes but is not limited to; sexual victimization, issues relating to sexual identity or problematic relationships, engaging in substance abuse and other risky behaviours. This study highlights the importance and benefits of understanding why mental health issues exist in young adults and students as they can have implications on mental health and well-being later in life. Mental health issues, such as anxiety, can also impact and influence a person's tendency for alcohol or substance abuse, have an impact on academic success and future employment and can lead to problematic relationships. It is the student population that is targeted, as stressors in college and university life can exacerbate these problems (Eisenberg et al., 2007).

Studies conducted on the student population show that there is a significant gap in helping students deal with mental health disorders in general, especially anxiety. Research on students show that the high rate of students diagnosed with mental health disorders is alarming and that there is a desperate need for primary and secondary prevention measures to be implemented (Bayram & Bilgel, 2008). Some researchers also suggest that anxiety is prevalent in a student population because there is a lack of adequate support services for this group of people as they enter this stage of study (Bayram & Bilgel, 2008; Rawson et al., 1994).

With numerous studies around the psychophysiology, conditions required, causes of, physiology and the prevalence of anxiety, there is a significant gap in the research and work on anxiety that needs to be met. To fill this gap, how individuals can be diagnosed efficiently and effectively with an anxiety disorder, and to not go undiagnosed, particularly in the student population, needs to be further explored. Identifying the reason for the anxiety presenting itself (state or trait) can be a significant factor in helping to diagnose and treat anxiety. All mental health disorders, including anxiety, have different aspects that contribute to the overall presence of the disorder. The present study explored how the environment (state) and personality characteristics (trait) of an individual can contribute to the evolution of an anxiety disorder, and how differentiating between state and trait anxiety is essential for correct diagnosis and treatment.

Why Anxiety is a Problem

Anxiety is considered a problem as through research, anxiety disorders are becoming increasingly recognised as one of the leading factors and causes of poor or declining health in individuals, resulting in them having a dependency on the health service sector (Dean, 2016). Anxiety has many adverse effects on an individual's physiological and mental state, so is a major problem for individuals who suffer from it. Ghinassi (2010) states that anxiety is a problem because it has negative implications on a person's physical health, morbidity rates, puts pressure and a reliance on the health care system and can decrease workplace productivity. Anxiety disorders are a major problem that health sectors are faced with in the 21st Century. Unlike other disorders such as depressive episodes, anxiety disorders generally persist and reoccur constantly and consistently throughout one's life even when treatment is sought (Ghinassi, 2010).

Someone who suffers from anxiety is likely to have at some stage implemented negative avoidance behaviours. Through these negative behaviours such as avoiding anxiety-inducing experiences, a state of temporary relief is felt through this momentary avoidance of a perceived anxious situation. Thus, the avoidance behaviour is reinforced, as feelings of wariness, agitation and being frightened are temporarily reduced. This is problematic as it is only a temporary short-term fix and instead of addressing the anxiety and the problems it causes, to help an individual in the future, it instead has further compounding negative impacts (Powell & Enright, 2015)**.** Moreover, anxiety is a problem because of the comorbid relationship anxiety has with other mental health disorders. This is a problem because comorbidity puts an increased pressure on medical services, increases the chances of depression, suicidal ideation and risk, loss of productivity for the individual and has implications on treatment (Ghinassi, 2010). In one study that Ghinassi (2010) investigated, 50-55% of those that suffered from anxiety met the criteria for two or more mental health disorders with a rate of 76% for a lifetime prevalence. In lots of cases where an anxiety disorder or disorders are present, there is often a heavy reliance on alcohol and drugs, making this a bigger problem and even more problematic to diagnose and treat.

Furthermore, as researched by Ghinassi (2010), anxiety is a problem as it can lead to drug abuse, and specific anxiety disorders such as panic disorder and social anxiety disorder can commonly steer individuals towards the use of illicit drugs, alcohol and addictive substances. The person can then become reliant on these substances which in turn can have an adverse effect, by exposing them to more anxiety-inducing events, thus, worsening the already turbulent anxiety disorder. If the anxiety can be more accurately diagnosed through defining the cause of the anxiety as either state or trait, once this distinction has been made a more accurate diagnosis can be made, and thus, a more effective treatment plan implemented.

Conclusion

With the World Health Organisation stating that one in 13 people suffer globally from anxiety, it is without a doubt concluded that anxiety is a problem that is worth exploring. More focus on anxiety research needs to be undertaken so anxiety can be diagnosed, assessed and treated correctly before it manifests itself into an anxiety disorder or becomes a comorbid disorder that puts strain on the economy, medical services and health sectors. Nothing can be done to improve the worsening situation around anxiety, with anxiety rates increasing yearly, unless an accurate distinction between state and trait can be made. Anxiety and the reasons for its appearance needs to be investigated further using well validated assessment tools not affected by measurement error. This is important due to many individuals who present with anxiety also suffering physical effects from the anxiety, which includes gastrointestinal problems, cardiac disorders, hypertension, migraines and other mental health disorders such as chronic stress and depression (Ghinassi, 2010).

Measurement of anxiety need to be enhanced to achieve clinically required precision. When a measure can differentiate between state and trait anxiety, a more precise diagnosis can be made. Catching anxiety early with a more accurate diagnosis can significantly reduce the chance of the anxiety turning into an anxiety disorder (Mahmoud et al., 2012). However, an accurate diagnosis cannot be made without an accurate measurement that allows state and trait anxiety to be separated. Once the distinction between state and trait anxiety has been made through accurate measurement tools and applied methodology, such as G-theory, the biological and genetic components of anxiety may aid in differentiating and treating the different anxiety disorders. This is an important area of anxiety that clinicians and those who treat anxiety should be largely exploring. The future ability of combining the methodology techniques of separating state and trait anxiety with genetic research to help treat, prevent and predict anxiety, to help stop and reduce anxiety levels in individuals, will become fundamental to future treatment and diagnosis of anxiety (Ghinassi, 2010).

It needs to be recognised that a predisposition to anxiety through genetics, environments, learnt behaviour, stressors, brain imbalances and abnormalities, makes a person more prone to experiencing stress and so in turn experiencing and developing impairing anxiety (Ghinassi, 2010). Thus, the importance of exploring the differentiation between whether a person experiences state or trait anxiety is more pertinent than ever to the treatment and diagnosis of anxiety, to try and begin to curtail this vicious disorder before it progresses and develops further. All efforts need to be put into the study and research of anxiety and all aspects that it encompasses. An emphasis needs to be placed on anxiety research in order to stop and reduce the effects this phenomenon already has on 15-25% of society. This will aid in helping to stop the alarming rate at which anxiety levels are so far continuing to rise, before it wreaks havoc and aversively affects individuals further. Thus, curtailing the effects of anxiety on society can only be done by applying appropriate methodology which will be the most effective and efficient, such as G-theory, to accurately distinguish between and separate state and trait anxiety within a measure, such as the STAI.

Chapter 2 Measuring Anxiety

Anxiety Measures and their Properties

To accurately look at differentiating between state and trait aspects of anxiety a look at what measures can do this most effectively and efficiently need to be investigated. A tool used to measure any mental health problems or disorder needs to consider external factors that could affect the results of the measure to ensure results are reliable and valid. Reliability correlation coefficients for trait aspects of a measure should be enduring and consistent over time, as trait aspects refer to a person's predisposition to experiencing trait anxiety, due to a person's genetics and personality. Whereas, reliability correlation coefficients for state anxiety should be dynamic over time, as state anxiety is caused by environmental factors present that induce anxiety, thus, state anxiety correlations should fluctuate. Factors that can affect the reliability of a measure over time could be: item wording, did the participant interpret the question correctly, what type of person are they, the present mood of an individual the day of testing, what events have already taken place that day that could affect their mindset, are they tired, did they sleep well the night before and have they got other stressful events going on in their lives at the time of testing that could affect measurement results.

It is important that a differentiation of state anxiety from trait anxiety is made, so an individual's anxiety can be diagnosed and treated appropriately. In order to make this diagnosis, that distinguishes between state and trait anxiety needs to be used along with appropriate methodology to make this distinction. This distinction needs to be made so if it can be determined that an individual is presenting with state anxiety and not trait anxiety, through removal of a stimulus that causes anxiety, it can help determine that the anxiety presenting itself is not due to trait anxiety and is in fact state anxiety, so does not need a diagnosis or treatment plan. Therefore, if it can be determined that a person is experiencing state anxiety, which is part of normal life experiences for everyone, a diagnosis and treatment plan for someone presenting with state anxiety is not necessary. Whereas, trait anxiety is a problem, and reoccurrence can lead to onset of an anxiety disorder which does need a diagnosis and treatment plan.

The differentiation for state and trait anxiety is needed in the area of psychology, to evaluate a person's risk of developing a mental health condition, stemming from their trait factors for anxiety, so it can be distinguished from effects associated with environmental influences which will influence state anxiety. Thus, the need to accurately measure anxiety in clinical and research contexts, motivated development of different anxiety measures used to measure anxiety. Some of these measures identified as suitable to measure anxiety include; Beck Anxiety Inventory (BAI), the STAI, Social Phobia Inventory (SPIN), Penn State Worry Questionnaire (PSWQ), Hamilton Anxiety Scale (HAM-A), Generalised Anxiety Disorder Scale-7 (GAD-7), Hospital Anxiety and Depression Scale-Anxiety (HADS-A), and others (Julian, 2011).

Properties of these anxiety measures are outlined in Table 1. Most of the measures identified as appropriate for measuring anxiety are designed on a questionnaire style structure. Some measures are better validated compared to others; the BAI is one of the most cited measures for anxiety with over 300,000 Google citations compared to the HADS-A with less than 7,000. Most of the measures have a generally high internal consistency for measuring anxiety with coefficients for all anxiety measures identified ranging from 0.77-0.99. However, they all have varying levels of test-retest reliability, validity and reliability across the measures with coefficients for all the measures identified excluding the STAI, having generally good to high test-retest reliability for anxiety, with coefficients ranging between 0.62-0.94 (Child Outcomes Research

Consortium, 2020; Connor et al., 2000; Hamilton, 1959; Julian, 2011; Leichsenring, 2006; Letamendi et al., 2009; Maier et al., 1988; Meyer et al., 1990; Rutter & Brown, 2017). Test-retest reliability for the STAI is generally high but the two subsets of state and trait need to be considered separately, as state reliability should be low over time. This is evident with coefficients for the trait subscale of the STAI ranging from 0.73-0.94 and coefficients for the state subscale ranging from 0.16-0.96 (Barnes et al., 2002; Spielberger et al., 1983).

Table 1

Comparison of Properties of Common Measurement Tools used to Measure Anxiety and the Number of Citations of Each in Google Scholar (13 July 2020) presented in descending order.

Measure	Google scholar citations	No. of items	Internal consistency Cronbach's Alpha	Temporal reliability, test-retest or intraclass coefficient	State-Trait	Limitations
Beck Anxiety Inventory (BAI) (Julian, 2011)	310,000	21	0.90–0.94	0.62–0.93	Unclear	- Limited scope of symptoms - Overlap with depression - Focus on somatic symptoms
State and Trait Anxiety Inventory (STAI) (Barnes et al., 2002; Julian, 2011; Spielberger et al., 1983)	78,600	40 (20 state 20 trait)	0.86–0.95	0.73-0.94 (trait) 0.16-0.96 (state)	State and Trait	- Sensitivity to change can be hard to interpret due to the understanding of how both subscales measure anxiety
Social Phobia Inventory (SPIN) (Connor et al., 2000; Letamendi et al., 2009)	69,700	17	0.91	0.70	Unclear	- Poor reliability in the physiological subscale - Lack of empirical support for the scale - Complex scoring - Ambiguous terms
Penn State Worry Questionnaire (PSWQ) (Meyer et al., 1990)	33,300	16	0.91-0.95	0.93	Trait	- Overlap with depression - Reverse worded items
Hamilton Anxiety Scale (HAM-A) (Hamilton, 1959; Leichsenring, 2006; Maier et al., 1988)	9,840	14	0.77–0.92	0.74	Unclear	- Poor in discriminating between symptoms and disorders - Does not cover 'worry' - Results based on clinician interpretation - Overlap of anxiety and depression
Generalised Anxiety Disorder Scale-7 (GAD-7) (Child Outcomes Research Consortium, 2020; Rutter & Brown, 2017)	9,740	7	0.84–0.99	0.68–0.82	Trait	- Specificity of symptoms can be poor - Does not discriminate between anxiety disorders in the lower spectrum of anxiety
Hospital Anxiety and Depression Scale-Anxiety (HADS-A) (Julian, 2011)	6,760	7	0.84–0.90	0.94	Unclear	- Does not detect the presence of specific anxiety disorders - Focuses on generalised anxiety disorder

Note: data shown in Table 1 has been generalised based on the literature review.

Notwithstanding, even though the BAI is highly cited, it is unclear exactly what the BAI measures in terms of state and trait anxiety. The BAI is a self-report questionnaire which requires participants to respond to questions in terms of 'how they felt over the last week', with a large focus on somatic symptoms. Therefore, the BAI is not seen to directly measure either state or trait anxiety and largely assesses the physical symptoms of anxiety (Julian, 2011; Kohn et al., 2008). The SPIN is another self-report questionnaire where the 17 items are to be responded to by the participant in terms of 'how much the statement applied to themselves over the past week'. The items focus on assessing how an individual will feel in social situations and so it might be seen to be measuring trait anxiety. It is unclear what type of anxiety the SPIN measures due to the ambiguity of questions (Connor et al., 2000; Letamendi et al., 2009). Similarly, the PSWQ is a self-report questionnaire designed to predominantly measure trait anxiety, with a focus on traits that influence the amount of 'worry' a person will experience. Participants respond to items in terms of how 'typical or characteristic each item is of themselves'. Therefore, the PSWQ largely assesses cognitive traits of anxiety and is often paired with the BAI for its focus on somatic symptoms (Meyer et al., 1990).

Moreover, the HAM-A is a clinician assessed questionnaire which has also proven to be unclear in whether it measures state or trait anxiety and was originally designed to assess the severity of anxiety presented. The clinician who administers the questionnaire is to assess each of the 14 items and evaluate them individually, and the extent to which a patient exhibits them (Hamilton, 1959; Leichsenring, 2006; Maier et al., 1988). The GAD-7 is a seven-item self-report questionnaire which is shown to largely measure trait anxiety over state anxiety. It can be concluded that it measures trait anxiety and not state anxiety as items are responded to, by participants, in terms of 'how bothered they have been' with the seven items asked, over the last two weeks (Rutter &

Brown, 2017). Additionally, the HADS-A is a seven-item self-report questionnaire which focuses on assessing the presence of general anxiety. The seven items are to be answered in the context of how the participant has ‘felt in the last week’. However, the items provide an unclear picture to whether they measure state or trait anxiety, due to the confusing nature of the questions such as, ‘I feel tense and wound up’, which could be interpreted to be how participants felt at the time of testing instead of in the last week (Julian, 2011).

Finally, the STAI has shown to accurately represent both state and trait anxiety. A main advantage of the STAI over other anxiety measures is that its design splits anxiety into two subscales, state and trait, and has items designed to specifically measure and assess the two aspects of anxiety separately. It is also easy to administer and score and is one of the most commonly used and researched measures for general anxiety. Thus, the STAI is a more appropriate measurement tool for measuring anxiety. Compared to other measures, the STAI measures and differentiates between both state and trait anxiety, where other measures don’t, as identified in Table 1, and it has 78,600 Google citations, making it the second most highly cited measure. It is a questionnaire-based measure which is a self-report with a likert scale design for its 40 items. It is found to have high internal consistency for anxiety and better test-retest reliability, validity and reliability than other measures (Barnes et al., 2002; Julian, 2011; Spielberger et al., 1983). A measure that differentiates between the two subscales of anxiety is important as it will be beneficial in helping to separate state from trait anxiety components of a measure, and thus, contributes to creating a more effective treatment plan and diagnoses for patients.

Apart from the STAI the other anxiety measures identified can only measure one of state or trait anxiety or be unclear in its measurement design as to what it measures (Table 1). Excluding the STAI, other anxiety measures cannot measure both state and trait anxiety without introducing assessment bias. The other anxiety measures such as, the BAI, GAD-7, HAM-A, PSWQ, SPIN and HADS-A, were not developed to specifically differentiate between state and trait anxiety in the same questionnaire as the STAI. It can also not be assumed that they measure both state and trait anxiety, as this leans towards uncertainty of the measure, which is why appropriate methodology needs to be applied to anxiety measures to fully investigate their psychometric properties. Therefore, the STAI is the only suitable measure that can be used to differentiate between state and trait anxiety, which will enable accurate diagnosis and assessment of anxiety.

State and Trait Anxiety Inventory (STAI)

The 40-item STAI, first developed in 1983 by Charles Spielberger, is a self-report questionnaire which was designed to measure both state and trait anxiety, and it is supposed to differentiate between the two (see Appendix B) (Marteau & Bekker, 1992; Spielberger 2012). It is widely used to measure and diagnose anxiety-like symptoms across both subscales (American Psychological Association, 2019). Each subscale has 20 questions, the first 20 items assess state anxiety and evaluate a person's current state of anxiety, ("I am tense" and "I am worried") and the last 20 items assess trait anxiety assessing how someone generally feels, ("I lack self-confidence" and "I am a steady person"). The STAI uses a 4-point Likert scale from "almost never" to "almost always", 1-4, with 1=not at all to 4=very much for state anxiety items, and 1=almost never to 4=almost always for trait items, with higher scores showing greater levels of anxiety (Julian, 2011).

The aim of this measure is to measure and differentiate between the existence and severity of current symptoms of anxiety from an inherited or generalised tendency to be anxious. This distinction is important so clinicians can determine the best course of treatment. Interpretation of scores is done through a sum of scores for each subscale, with each subtest having a range of between 20-80. The higher the score the higher the prevalence or indication of anxiety. Scores between 39/40-80 suggest clinically significant symptoms for state anxiety on the state subscale (Julian, 2011). It is a questionnaire that in its standard form is directed at and intended to be administered to adults of 18 years of age or older, to indicate how intense feelings of anxiety are for a person. Having been translated into several different languages such as, English, French, Chinese and Spanish it is now a well recognised measurement tool amongst clinicians and people in medical settings.

The inventory was created so it could be used as a complete set of questions towards helping assess specific types of anxiety (Spielberger & Sydeman, 1994). Some information used in the creation of this was developed by researching, investigating and modifying other forms of measurement. Once the inventory had been developed it was tested and researched to establish if it could be considered a useful valid and reliable tool for making assessments on anxiety (Spielberger & Sydeman, 1994). It developed short and reliable scales when implemented in a clinical setting, which are derived from a person’s answers to their awareness and ability to recall on their state and trait anxiety, and to distinguish anxiety from depressive symptoms (Spielberger et al., 1983). Overlap can exist between anxious and depressive symptoms, for a measure, such as the STAI, to be reliable it must extinguish the possibility of anxiety symptoms showing as depressive symptoms or vice versa. Differentiation between anxiety and overlapping depressive symptoms, is just as important as differentiating between state and trait anxiety for accurate diagnosis and treatment.

As anxiety presents itself in several ways such as feelings of unease and stress, it can often be related to an event coming up, such as an exam or test which causes the anxious feelings (state). Or, the underlying cause for these symptoms and feelings can be caused by anxiety disorders such as social phobia and GAD (trait) (Nolen-Hoeksema, 2011). Thus, the STAI is unique and advantageous as it aims at testing the two different subscales of anxiety, state and trait, which helps to determine what is the cause of the anxiety. As state anxiety is considered when fear and feelings of nervousness, engage the processes of the autonomic nervous system, at a given time, and a person perceives a situation, event or environment to be dangerous or threatening (Friedman & Thayer, 1998; Spielberger & Sydeman, 1994). This kind of anxiety is considered temporary and symptoms and side effects of state anxiety should dissipate when the perceived danger is eliminated. Contrary to this type of anxiety, trait anxiety is when the person feels stress or discomfort daily, and how a person feels across situations that are considered normal everyday tasks and typical situations that everyone experiences (Spielberger & Sydeman, 1994). When the cause of the anxiety can be identified through assessment of a measure that enables a distinction between state and trait, diagnosis and treatment made from this is more effective and appropriate.

Since its development the STAI has been modified from its previous Form X in 1983 to its current and most recent version, Form Y (Spielberger et al., 1983). The revised Form Y replaced items from Form X, as it has a simpler structure than Form X, and items for the two subscales of anxiety were differentiated further to be able to accurately define state and trait anxiety factors most effectively (Spielberger & Sydeman, 1994). There are several other modified forms of the STAI that exist and should be administered appropriately depending on the demographic the questionnaire is being administered to. These include, State-Trait Anxiety Inventory for Children (STAIC), Test

Anxiety Inventory (TAI), State-Trait Anger Expression Inventory-2 (STAXI-2) (eProvide, 2016).

An advantage of the STAI is that results are quickly summarised giving the assessor an insight into the anxiety quickly. With 20 questions for each subscale of the STAI, it was designed so each 20 questions for each subscale are supposed to measure that aspect of anxiety only. In order to achieve this, this meant that the 20 questions for each subscale are different (Spielberger & Sydeman, 1994). Questions are to be answered considering the two contexts for the state and trait questions. Items 20 and 21 are the same, ('I feel pleasant'), but participants are to consider the context of the question before answering, as one falls under the state subscale and one falls under the trait subscale (Julian, 2011). Questions that are specific to each subscale help in determining whether someone is presenting with state or trait anxiety.

As individual items are rated on a four-point likert scale, from 1-4, after scores have been totaled an indication of the form of anxiety is shown. Low scores start at 20 and indicate a mild form of anxiety, median scores indicate a moderate form of anxiety, and high scores, which can go up to 80, indicate a severe form of anxiety (Grös et al., 2007; Kameg et al., 2014; Spielberger & Sydeman, 1994). Both subscales of the STAI include anxiety absent and anxiety present questions, where anxiety absent questions represent the absence of anxiety such as 'I feel secure' and 'I feel calm. Anxiety present questions are ones that represent anxiety such as 'I am presently worrying' and 'I feel nervous', (Spielberger & Sydeman, 1994). Reports of internal consistency for the STAI are generally high and test-retest is good. Expectantly, due to the dynamics of this measure, trait anxiety is less responsive to change than state anxiety. Strengths of the STAI include; one of the most widely researched and used measures of general anxiety, brief administration and scoring is interpreted quickly, interpreted in over 40 different languages and attempts to distinguish what kind of anxiety is present by having two subscales of anxiety. Thus, though they are limited, it has its disadvantages; cut-off scores for identifying anxiety can sometimes be ominous and there can be poor validity for differentiating between anxious and depressed states (Carey et al., 1994; Julian, 2011).

Controversially, whilst the STAI has a larger number of items than other anxiety measures, this can be perceived as both a weakness and a strength of the STAI at different times. In a study conducted by Spielberger and Reheiser (2009) that investigated assessment of emotions such as anxiety, anger and depression, the STAI was completed by high school and college students, working adults and military recruits, to measure and assess levels of anxiety. Through use of the STAI, Spielberger and Reheiser (2009) explain their findings and support for the STAI being a reliable and valid measure in assessing anxiety. Correlation coefficients for test-retest stability for trait anxiety were high ranging from 0.73 - 0.86, and low for state anxiety, with a median coefficient of 0.33, with internal consistency for state and trait being 0.93 and 0.90, respectively.

As will be further addressed in more depth later, these correlation coefficients support the notion that the STAI is a valid and reliable measure. It is expected that trait anxiety will be stable over time and state anxiety should fluctuate between assessments, as state anxiety, at the time of testing, is supposed to reflect the impacts of unique environmental or situational factors. These results are desirable. Additionally, to further prove the validity and reliability of the STAI, the internal consistency scores for anxiety in this study were strong and uniformly high for both state and trait anxiety, with median coefficients of 0.93 and 0.90 respectively. Furthermore, it is the leading measure worldwide as a tool to measure personal anxiety, it was designed to be implemented across a range of socio-economic statuses, it is widely used to differentiate between anxiety and depression, and different types of anxiety and can be implemented in both clinical and medical settings. Finally, with the development of the STAI, its ability to distinguish between the two subscales of the STAI is significant. A measure that can differentiate between state and trait anxiety will be able to establish a more efficient and effective diagnosis and treatment, for an individual who presents with anxiety over other measures.

Limitations of the STAI

Whilst the STAI has strong advantages over other anxiety measures it has not been without its limitations in previous research. To get a thorough overview of the STAI it is important to look at these limitations of the STAI as an anxiety measure and understand why they exist. In the past the STAI has generally been implemented with, and reliability and validity been examined, through test-retest methodology and correlations. There are implications of using test-retest correlations, as they are not a strong tool for analysing the STAI and being able to distinguish between state and trait anxiety. These will be discussed in further detail in the following chapter, but in brief, problems with test-retest correlations include, inconsistent research findings, not considering variability of individual items, and not considering interaction errors and variance in measurement error over time (Brennan, 2001; Winterstein et al. 2010). Simply put, test-retest correlations just compare scores over two different time-points to get a total score correlation without considering the variable changes which can occur between testing and at the individual symptom/item level (Medvedev et al., 2017; 2018).

In research, the STAI with the use of test-retest correlations has been found to have inconsistent reliability over time as it does not consider multiple sources of variance affecting the measurement. Therefore, the application of test-retest methodology to the

STAI is untrustworthy. A distinction between state and trait anxiety using an overall total score through test-retest correlations is not an accurate measure of the STAI and its ability to distinguish between the two subscales of anxiety. Whilst test-retest correlations have been applied to the STAI in the past, there are more advanced methods such as G-theory which can be applied to the STAI to more precisely distinguish between state and trait anxiety and eliminate the limitations of the STAI mentioned.

Conclusion

To conclude, there are many measurement tools that can be used to measure anxiety. The STAI is the first of its kind in its ability to differentiate state anxiety from trait anxiety, which makes it a more effective measure of anxiety over other anxiety measures mentioned in Table 1. This makes the STAI the only relevant measure for measuring anxiety as it is the only measure that claims to allow these two aspects to be assessed separately. However, there is no robust evidence to support that the STAI is the only suitable measure, which is why further research of the STAI which emphasises its ability to make this distinction between state and trait anxiety needs to be carried out as it has not yet been rigorously tested using appropriate methods. All other measures, such as the BAI, SPIN, PSWQ, HAM-A, GAD-7 and HADS-A, are not designed to measure state and trait simultaneously and have several limitations making them less suitable for the current study purpose. Thus, making the STAI the most suitable measure to use, as limitations of other measures decrease the ability of assessment of anxiety.

For example, the BAI is not suitable for measuring anxiety as it assesses a limited scope of symptoms, with a focus on somatic symptoms, and it measures symptoms which have overlapping qualities with depression and struggles to separate the two (Julian, 2011). Additionally, the SPIN also has its limitations and is problematic due to poor reliability in the physiological subscale, lack of empirical support, complex scoring and ambiguous terms of 'opposite sex'. It is unclear whether the SPIN measures state or trait anxiety, therefore, is inappropriate as a measure to differentiate between state and trait anxiety (Connor et al., 2000; Letamendi et al., 2009). Furthermore, problems also arise when implementing the PSWQ to assess anxiety with its focus on assessing trait anxiety, use of items that can assess both anxiety and depression, and reverse worded items (Meyer et al., 1990). These limitations create issues and are problematic for the reliability and validity of the PSWQ over time.

Similar to other anxiety measures, the HAM-A also has limitations due to the measure being unable to discriminate between symptoms of anxiety and an anxiety disorder, as well as having an overlap of items that could measure both anxiety and depression, and it does not measure 'worry'. The HAM-A is also clinician rated, so can lead to assessment biases and because of this it is unclear as to whether the measure is assessing state or trait anxiety (Hamilton, 1959; Leichsenring, 2006; Maier et al., 1988). Moreover, limitations for the GAD-7 include, a focus on trait anxiety only, has poor specificity of symptoms measured, and does not discriminate between anxiety disorders in the lower spectrum of anxiety (Child Outcomes Research Consortium, 2020; Rutter & Brown, 2017). Problems arise with the GAD-7 when it only measures trait anxiety, as it is not allowing for anxiety that could be present due to the normal experience of state anxiety to be eliminated. Next, the HADS-A is limited in being able to detect the presence of specific anxiety disorders and has a focus on assessing generalised anxiety disorder (Julian, 2011). This is a problem for the HADS-A as it can lead to assessment bias for certain types of anxiety disorders.

Although limitations of the STAI have been previously highlighted, these limitations occur mainly when the STAI is analysed through test-retest correlations.

These limitations which include the inability to distinguish state and trait anxiety effectively, due to test-retest scores not considering variance of measurement error and only deriving an overall total score across two time-points, decrease the reliability and validity of the STAI in research. These limitations of the STAI that are emphasised through test-retest correlations, highlight the importance for further research in distinguishing state anxiety from trait anxiety using other methodologies.

G-theory methodology, which will be discussed later, is constantly proposed by researchers as the most suitable and increasingly used method for the purpose of distinguishing between the two aspects of anxiety (Bloch & Norman, 2012; Brennan, 2001; Briesch et al., 2014; Cronbach et al., 1963; Medvedev et al., 2017; Paterson et al., 2017; Prion et al., 2016; Rezazadeh & Tavakoli, 2009; Salkind, 2010; Shavelson et al., 1989; Shavelson & Webb, 1991; Van Agt et al., 1994;)**.** When a move away from trying to differentiate state anxiety from trait anxiety through test-retest scores is made, and instead implement methods such as G-theory, more reliable results which allow a more accurate distinction between state and trait anxiety are obtained. Therefore, combine the STAI with the methodology of G-theory, which the present study does, as it takes into account the variable changes in a person over time and measurement error, and there is an irrefutably robust measure for measuring anxiety and differentiating between state and trait to provide a more accurate treatment plan.

Chapter 3 Differentiating State from Trait

Classical Test Theory (CTT) and Test-retest Reliability

Over decades Classical Test Theory (CTT) has been one of the most significant methodologies used to assess reliability of psychometric tools such as the STAI. CTT focuses on the overall source of error where scores are acquired on the bases that an observed score on a test is the sum of a true score and error (Lord & Novick, 1968). CTT assumes that the true score and measurement error are the two principle sources of variance, where anything not attributable to the true score variance is included in the measurement error and refers to ‘error variance’ (Prion et al., 2016). Factors that make up measurement error can be random or non-random, and include; internal, external, instrumental-specific issues and rater issues. Where random error is what can jeopardise the reliability of measurement (Brennan, 2001).

Therefore, CTT does not allow for the partitioning of error into different sources. This makes it problematic for a researcher to identify and pinpoint the exact source of error and use this information to enhance assessment and improve research design. If adjustments can be made based on accurate source of error scores, more reliable results can be obtained (Bloch & Norman, 2012; Prion et al., 2016). Given that CTT only deals with these two components to derive an observed score, it has been suggested that CTT is an over simplified version of reality and does not breakdown aspects of situations that arise during testing which could affect scores and results (Brennan, 2001; Winterstein et al. 2010).

Furthermore, CTT provides the most frequently used methodology to assess temporal reliability. Temporal or external reliability denotes the consistency of a measure over time and after repeated trials is the extent to which coefficient results obtained for each trial would be the same. Internal reliability, also known as internal consistency, is how consistent items are in reflecting if a latent construct has been measured, which is estimated by inter-correlations between scale items (Streiner, 2003). Internal reliability should, for items measuring the same thing, show strong correlations with each other, where, temporal reliability and test-retest coefficient scores are different from the overall score and internal reliability. The assumption of reliability is based on correlation coefficients, derived from test-retest scores, where obtaining test-retest reliability coefficients use a total score correlation to compare scores at two different time points. The test-retest reliability correlation coefficient value is between the sum of the two observed scores, which becomes the overall reliability coefficient value under CTT methodology (Truong et al., 2020). The reliability calculation is derived on sums across items but requires the assumption that statistical conditions have been met.

Test-retest reliability scores are frequently used to determine the distinction between state and trait measures. Where, a stronger correlation between test scores at two different time points is characteristic of a trait measure (e.g. >0.70), while correlations below 0.60 are considered to indicate a state measure (Medvedev et al., 2017; Spielberger et al., 1970, 1999). It is essential to the diagnosis and treatment of anxiety that state and trait anxiety be identified accurately through reliable methodology. Internal reliability coefficients are obtained through internal reliability methods, which are represented through coefficients derived from Cronbach's alpha (Van Agt et al., 1994). Cronbach's alpha determines how closely linked a set of items are within a group or test (Tavakol & Dennick, 2011). Whilst Cronbach's alpha is appropriate for comparing scores at the same time point between people, it is not a strong or reliable measure of scores taken over time (Paterson et al., 2017). It is important to understand item, occasion and person variances over time to understand reliability coefficients, so a distinction between state and trait symptoms can then be made. This is what CTT and test-retest reliability scores do not do, which makes them unreliable and inappropriate methodology for distinguishing between state and trait anxiety. To get a ‘true’ reliability score, the extent to which assessment scores are generalisable across multiple situations or contexts by simultaneously considering multiple sources of error affecting the measurement would need to be evaluated (Shavelson et al., 1989).

To further prove the significance of applying appropriate methodology to assess reliability, it is expected that the personality characteristic of trait anxiety will be enduring over time and the presence of state anxiety will fluctuate. The fluctuation depends on the person and occasion interaction at the time of testing, which presumably would be different over different time points (Spielberger et al., 1983). Thus, test-retest correlation coefficients of the STAI for the trait scale (0.73-0.94) are generally higher than scores on the state scale (0.16-0.96), which if this is so, can help denote a reliable method for assessing anxiety through an anxiety measure (Barnes et al., 2002; Spielberger et al., 1983). However, test-retest reliability correlation coefficients have been shown to be unreliable indicators, as stated in Barnes et al. (2002) study, where for the STAI, test-retest maximum coefficients for the state scale (0.96) were found to be higher than the trait scale of the STAI (0.94).

Therefore, using an overall total score through CTT methodology and analysis, will not reliably detect state changes using test-retest correlation coefficients. As, if overtime, an increase in one item occurs and another item decreases by the same amount, it will not produce any change in the total overall score. This means state changes over time will not be evident, as it does not allow for an accurate distinction between state and trait, nor establish reliability over time. Thus, factors related to potential measurement error due to person, item, occasion and their interactions are not being accounted for in the total score of CTT, resulting in unreliable test-retest reliability coefficients (Medvedev et al., 2017, 2018). Thus, through implementation of an anxiety measure using test-retest reliability correlations under CTT methodology, an accurate distinction between state and trait anxiety cannot be made. Due to accuracy of the assessment being compromised which may impact on the diagnosis and treatment of anxiety.

Furthermore, Finch et al.'s (1974) study, explored the reliability of state and trait anxiety in emotionally disturbed children, and found that the test-retest correlations were unreliable. Finch et al. (1974) derived test-retest coefficients for the State-Trait Anxiety Inventory for Children (STAIC) after implementing the STAIC in 30 emotionally disturbed children, with a three-month interval between testing and retesting. The study found test-retest correlation coefficients showed only moderate reliability with correlation coefficients for test-retest for state anxiety at 0.63, and for trait anxiety at 0.44. This is the opposite of what state and trait test-retest scores should look like according to Spielberger et al. (1983), who suggests that due to the transitory nature of state anxiety, higher trait anxiety test-retest scores over state anxiety should be evident. A total score using test-retest reliability will not show an accurate distinction between state and trait anxiety, but a method such as G-theory would, with its accountability of measurement error over all facets (Medvedev et al., 2017, 2018). Thus, test-retest reliability scores obtained through CTT methodology, are not reliable, so cannot be trusted to accurately distinguish between state and trait anxiety aspects, for a measure over time. Finally, if variances which contribute to measurement error are not accounted for, it limits the reliability of methods assessing anxiety within a measure, as they can become less accurate.

Limitations of CTT Methods

Overall, limitations of traditional CTT methods mean an accurate representation of psychometric tools over time is not obtained. CTT limits itself due to categorising potential sources of variance into only two categories, true score and measurement error. This means pinpointing sources of error accurately, such as error due to the person, items and occasion, is not possible, as these facets are all accounted for under measurement error and not as individual facets. Due to CTT's limited partitioning of measurement error, CTT as a measure of reliability is largely considered one-dimensional in its error calculation. This is largely due to CTT only accounting for one aspect of reliability, thus, limiting its effectiveness in assessing reliability of an anxiety measure over time. Another limitation of CTT is that unlike other methodologies it cannot provide estimates of accuracy for a measure. CTT also does not allow for an accurate distinction between state and trait anxiety, as it uses an overall total score and does not evaluate all major sources of error affecting measurement individually (Medvedev et al., 2018). Therefore, the importance of distinguishing between state and trait aspects of a measure and anxiety is lost.

Generalisability Theory (G-theory)

G-theory is a statistical approach increasingly used to assess the reliability of psychological measurement. G-theory was first developed in 1963 by Cronbach and his associates and it contributed to significant improvement of the reliability concept (Cronbach et al., 1963). G-theory is an extension of CTT, it gets its name, 'generalisability', because unlike other methodology it is used to estimate the extent to which assessment scores are generalisable across multiple situations or contexts by simultaneously considering possible sources of error affecting the measurement (Briesch et al., 2014; Medvedev et al., 2017). This is a strength of G-theory as in all research studies there are multiple sources of error at any assessment occasion. Thus, G-theory is more sophisticated, factoring into its error calculation a multitude of sources of error variance. It implements a more complex methodology design, to calculate the error of variance and each error source contributes to the overall score (Prion et al., 2016). Analysis of Variance (ANOVA) is used to calculate variance components for each potential source of error and their interactions, while accounting for objects of measurement that is usually a person (Paterson et al., 2017).

Sources of variability are called *facets* in G-theory, which are external factors or outside stimuli that can affect one's current or present mood (Brennan, 2001; Paterson et al., 2017). For example, in psychometric measurement, across multiple occasions, facets are *person, item* and *occasion,* with the person being the object of measurement. In terms of the STAI, G-theory acknowledges that individual items of the STAI such as assessment occasions and their interactions, can be sources of error (Bloch & Norman, 2012). A person can feel differently on any one day of testing due to fluctuations in mood, the time of day or specific circumstances in their life, that influence how they respond to each item at different times. These changeable factors from one day of testing to another contributes to the error of measurement obtained by a measure (Brennan, 2001). A so-called generalisability study (G-study) is usually conducted first and estimates a generalisability coefficient (G-coefficient) that reflects how generalisable the test scores are over assessment occasions and sample population. After conducting a G-study, a design study (D-study) involves experimenting with measurement design by increasing or decreasing facet levels, such as, number of items or occasions, aiming at optimising the reliability and generalisability of assessment scores (Breisch, 2014; Paterson et al., 2017).

G-theory significantly improves the accuracy of test reliability over other methods, such as test-retest, in its ability to distinguish between state and trait anxiety. G-theory provides the researcher with a conceptual framework and a set of statistical procedures, to allow an extensive and all-inclusive analysis of test-reliability, which is much more robust than test-retest reliability methods (Salkind, 2010). G-theory's ability to accurately make this distinction between the two subscales of anxiety is pertinent in being able to treat and diagnose people with anxiety accurately.

In a study conducted by Van Agt et al. (1994), test-retest reliability of health state valuations collected with the EuroQol questionnaire, were explored. G-theory analysis was applied to the EuroQol questionnaire, where it was found compared to other methods it was the most appropriate one to use in terms of its test-retest reliability. G-theory was most appropriate as a methodology that would analyse the effect of the moment of measurement, of health states and respondents, at the same time. Therefore, G-theory needed to be able to account for all sources of variance to the total amount of variance for the questionnaire, which is why G-theory was chosen. Van Agt et al. (1994) and his colleagues undertook extensive research to find suitable statistical methodology to do this. With most methods being unable to show the relative contributions of different sources of variance, it was found that G-theory was the only suitable statistical technique for this approach (Van Agt et al., 1994).

Therefore, G-theory has strong methodology, it acknowledges that assessment scores are generalisable and considers other sources of error or factors that come into play during testing (Shavelson et al., 1989). It is advantageous in its use of estimating generalisability over reliability, and in doing so, it identifies each facet within a measure as a possible source of error. Being able to identify variances means that items can be manipulated in future studies and can have greater control to create a D-study, where the reliability of different facets can be estimated (Medvedev et al., 2017; Paterson et al., 2017). If methodology applied to an anxiety measure considers all facets of measurement error, more reliable results will be achieved. Bloch and Norman (2012) state that G-theory's main use, to calculate the amount of error caused by each facet and the interaction of facets, make it more appropriate to analyse a measure, such as the STAI, to distinguish between state and trait anxiety items.

Moreover, G-theory accounts for numerous aspects of reliability, where CTT can only account for one, and where G-theory explores providing estimates of accuracy for a measure, CTT cannot (Bloch & Normal, 2012; Brennan, 2001). G-theory allows for researchers and studies to estimate these additional sources of error that contribute to the overall score, allowing for more reliable and valid results, and a deeper analysis of findings (Prion et al., 2016). Thus, making it the most appropriate methodology to use in differentiating between state and trait anxiety with the STAI. The reliability and validity of results are significant when exploring the distinction between state and trait anxiety, so administrators of the measure can more precisely diagnose and treat individuals suffering from anxiety. Thus, the distinction of state and trait anxiety through G-theory methodology is imperative for clinicians and practitioners diagnosing and then setting an appropriate treatment course for anxiety sufferers.

Using Generalisability Theory to Distinguish State from Trait

Spielberger (2010) proposed that anxiety can be defined in two ways, state and trait, and emphasised the importance to distinguish between the two. The first being an emotional state, and second, a personality trait, which is due to individual differences which contribute to anxiety experiences. The intensity, duration and how often a person experiences state anxiety is predicted by the level of trait anxiety presented. Therefore, state anxiety is a result of an interaction between an individual's trait anxiety and occasion (Medvedev et al., 2017). It is also vital to identify all factors that contribute to state anxiety to minimise assessment errors and inconclusive findings. As state anxiety is a temporary state of mind and being, and trait anxiety is enduring, everyone experiences some form of anxiety as part of life experiences. Thus, the distinction between state and trait aspects of anxiety is important for research and in clinical settings, to make a more definitive assessment and treatment plan. Making an assessment without thinking about other factors that could affect an individual's present state of anxiety, could result in assessment errors and draw inconclusive findings.

Trait assessment is important for helping to evaluate an individual's risk for developing a condition, such as anxiety or other disorders. State assessment is also important to help examine an individual’s immediate reaction to an event, situation or stimuli, such as public speaking, and seeing this reaction diminish when the event, situation or stimulus is removed (Starlet, 2013). This is where the use of G-theory becomes very useful to minimise assessment errors when differentiating between state and trait anxiety for more effective treatment, diagnosis and interventions (Bloch & Norman, 2012; Paterson et al., 2017).

Moreover, this leads to the argument of whether anxiety is more state based, or trait based. Treatment for state-based anxiety is not always probable or clear. If the individual is in the same environment or presented with the same stimuli that sets off anxiety on day one, it may not be a cause of anxiety on day two. This can be down to the variance of several different factors due to environmental and personal influences. These variable factors are why it is often thought that treatment for state anxiety is not always necessary, as it can with many individuals be a one-off occurrence and experiencing state anxiety does not always come with negative outcomes (Gidron, 2013; Horikawa & Yagi, 2012). Hence, trait-based anxiety points to an individual's personality characteristics which make them more likely to experience anxiety and in turn state anxiety. It has been noted that there is a relationship between anxiety and certain personality traits, those that are most noted are neuroticism and extraversion, which are often thought to have biological and genetic foundations (De Moor et al., 2006). Because of a person's personality traits, genetics and brain functioning, this can make a person more likely to perceive situations as threatening or fearful, where others do not, and present with anxiety symptoms (De Moor et al., 2006). If a person stemming from personality traits is more prone to feelings of worry, agitation, being on edge or are stressed easily, they are more likely to experience anxiety because of the traits they possess. Causes of anxiety stemming from state or trait factors, need to be determined during assessment of anxiety so proper diagnoses and analysis can be made accordingly.

An individual who experiences a large amount of anxiety due to personality traits, can have inherited some of these genes, such as a high functioning nervous system. A high functioning nervous system can therefore offset the anxiety triggers in the body and if an inherited abnormal brain functioning or hormone levels are present, then it can cause anxiety to be more prevalent in some individuals (Bystritsky et al., 2013; Maron & Nutt, 2017). It has been suggested many times over that there is an interaction and positive correlation between state and trait anxiety. Thus, those who present with higher levels of trait anxiety have an increased risk of experiencing state anxiety more often (Buss, 1989; Epstein, 1994). However, some studies theorise that anxiety is all situational and suggest that there is no trait-based attribute that contributes to the onset of anxiety in an individual. Some researchers suggest that anxiety is all situational and how much anxiety an individual will experience is down to how a certain situation or environment is perceived. Thus, it is the individual's interpretation of these experiences that can lead to a negative emotional state and therefore anxiety (Thapar & McGuffin, 1995).

In Thapar and McGuffin's (1995) study on twins, to attempt to disentangle the genetic (trait) and environmental (state/situational) factors of anxiety, the study found that trait was best explained by shared environmental factors. When an individual can pinpoint and figure out the connections that make them feel anxious in certain situations, they can start to resolve and decrease the level of anxiety experienced. The idea that an individual induces anxiety on themselves suggests that it is an individual's habits and lifestyle choices that cause a person to place themselves into stressful situations and induce stress and then the onset of anxiety. It is suggested that it is the situation that causes the anxiety and not personal factors to do with the individual, it is just a person's tendency to overestimate the level of personal danger due to the situation experienced. Therefore, the situation induces the trait effects of anxiety (Mathews & MacLeod, 1985).

However, despite this, it is clear from life experiences and observations that everyone will react differently to a situation. Therefore, refuting the theory that anxiety is all situational. Additionally, it is stated in literature on anxiety that it is undeniable that biological and genetic components are a factor in the development of anxiety disorders. It is often reported that there is strong evidence and research supporting the trait factor of anxiety. The trait factor is often referred to as neuroticism and is genetically transmitted, thus, supporting the theory and argument for trait-based anxiety (Ghinassi, 2010). Identifying if the anxiety is due to trait factors of an individual rather than state factors, will help to define why the anxiety is present and allow a clinician to come up with a treatment and diagnosis to combat the anxiety presented.

A study conducted by Beatty and Friedland (1990) exploring the type of anxiety around public speaking, found that trait anxiety significantly predicts state anxiety, and was the single best predictor of this and not the other way around. The researchers stated that often situations that seem to be state anxiety or situational in nature are often as a product of trait anxiety. Furthermore, anxiety is a product of the interaction of both state and trait anxiety, and it is the combination and interaction of life experiences, learning and culture (state), interacting with the biology and genetics (trait) of an individual. Therefore, it is important to acknowledge that both factors of anxiety exist so the cause of the anxiety, state or trait, can be identified in its infant stages. Anxiety, if identified early can help determine if a person is experiencing state or trait anxiety, so it can be caught before state anxiety develops into trait anxiety. Thus, early identification of what type of anxiety is present, state or trait, and differentiating between the two, can aid in a diagnosis and treatment, to help prevent the anxiety turning into a mental health disorder. It is pertinent to the treatment and diagnosis of anxiety to distinguish between state and trait anxiety to provide an individual with a more accurate diagnosis and treatment for the type of anxiety being presented (Paterson et al., 2017).

Lau et al.'s (2006a) study, explored the state-trait anxiety relationship through a behavioural genetic approach. The study highlights the importance of understanding the interplay between environmental risk factors and genetics and the role they play in the development of an anxiety disorder. When the two aspects align, this increases the vulnerability of the development of a disorder. This is due to the genetic influences of anxiety having been found to influence an individual's reaction towards negative life events, which may be a precursor for anxiety in some individuals and not to others (Lau et al., 2006a). In the study, Lau et al. (2006a) hypothesised that genetic effects (trait) on anxiety are expressed through stress reactivity (state). Data was collected through the implementation of several questionnaires, such as the State-Trait Anxiety Inventory for Children (STAIC) that both child and parent completed, reporting measures of anxiety and depression (Lau et al., 2006a). Results of this study were consistent with other research findings and the hypotheses, where trait anxiety is expressed through levels of state anxiety under threatening circumstances as a process of genetic vulnerabilities and environmental stressors (Lau et al., 2006a). The study concluded that state anxiety is largely affected by environmental factors and trait anxiety shows moderate genetic effects.

Therefore, it can be summarised that trait anxiety is conveyed through an inclination to respond with state anxiety under threatening or dangerous situations. With high levels of trait anxiety leading to higher likelihood of an individual presenting with cognitive and physiological symptoms of state anxiety in threatening situations (Lau et al., 2006a; Spielberger, 1966). Thus, the relationship between state and trait anxiety may be the tell of a process where the anxiety symptoms are as a result of a genetic vulnerability interacting with the environment (Lau et al., 2006a). This means that, trait anxiety can present as state anxiety. The study highlights the importance to be able to differentiate between whether a person is experiencing anxiety like symptoms because of a stressful situation being present or because the person suffers from anxiety and is more likely to be exhibiting these symptoms due to levels of trait anxiety. Once this distinction between what subscale of anxiety is causing the anxiety to present itself, a more accurate diagnosis can be made, and treatment plans can be devised for treating the anxiety and its cause.

In terms of the STAI, G-theory helps to differentiate between state and trait anxiety, and in the present study, to further aid in the state versus trait distinction of a measure, a D-study was conducted through the computing of data from the G-study. These mechanisms were used to calculate a D-study coefficient for each facet based on the original G-study investigation. The D-study deciphers whether in the case of the

STAI, if a greater or fewer number of raters (items/questions) are needed to create the most reliable and accurate measuring tool for anxiety. Whilst the D-study does this, it is an added advantage to G-theory as it allows the researcher to do this without losing the measures reliability value (Prion et al., 2016).

Therefore, if a study has been conducted and results show that the G-study has produced a G-coefficient of 0.71 with a study that consists of 25 items, it can reduce or increase the number of items in a D-study. If the number of items were reduced from 25 to 15, that might produce a G-coefficient of 0.84, meaning that through the D-study, a suggested stronger measure based on the G-study results has been created. This means different parameters, such as using less items or questions, to see what the effect the change of parameters has, on the G-coefficient, can be used, and whether the change in parameters through the D-study gives a stronger G-coefficient. Thus meaning, the accuracy of the estimate in this case, shows by decreasing the number of items present, which is what makes G-theory a more superior method than traditional reliability methods, can be improved (Prion et al., 2016).

For example, Lasater's (2007) study measured clinical judgement in nurse educators, and how they were to present it to students and assess it. A pilot tested rubric was used to describe and assess the development of clinical judgement. The rubric was a 10-item evaluation, the Quint Leveled Clinical Competency Tool (QLCCT) which was used to assess 29 nurse educators. It was initially used in conjunction with traditional reliability methods, such as CTT, and then the researcher compared these findings when G-theory was applied to the QLCCT. Using CTT, findings for this study showed interrater reliability was at 95% with confidence intervals of 0.869 (0.623 - 0.996), suggesting that 87% of the variance in scores was due to the raters (nurse educators). Whilst the remaining 13% of variance was indistinguishable and due to something else, so was categorised under unexplained variance or error. Lasater (2007) states that these are useful findings but having 13% of unexplained variance or error is not satisfactory. To try and gain a clearer understanding of the error variances G-theory was then applied to the QLCTT.

After implementing G-theory, the findings were more significant. The facet object of measurement was the person and the facet of generalisability was the simulation scenarios and items. Here, it was found with an interrater reliability of 0.986 (similar to CTT at 0.95), which suggests that no variance was due to the participants, 11% was due to the scenarios, 56% was attributable to the items, with 1% of the variance being due to the raters. These findings gave the researcher a more precise overview to more accurately identify what is contributing to the multiple sources of error variance. The interrater reliability of both CTT and G-theory were similar, the significant difference between the two reliability methods is that for G-theory it partitions error into several components making it the more robust method (Lasater, 2007; Prion et al., 2016). This aspect of G-theory is what makes it effective and well designed to help differentiate between state and trait anxiety in the current study, as the facets used in the current study can partition off variances in error between the person (trait), item and occasion (state). This is significant, as categorising sources of error will give an indication as to whether someone is presenting with state or trait anxiety in each situation or time. Thus, the distinction between state and trait anxiety helps to develop an accurate diagnosis of anxiety and create an effective treatment plan.

Additionally, another advantage of G-theory is how it enables the researcher to derive a State Component Index (SCI) for distinguishing between items measuring state anxiety from trait anxiety items. The present study uses the SCI and the parameters of an item score of SCI ≥ 0.6 for measuring state anxiety. Scores below this are unreliable as a state item measuring state anxiety. Whilst the parameter for an item measuring trait anxiety is SCI< 0.30. Several studies and researchers such as Medvedev et al. (2017, 2018) and Paterson et al. (2017), support the constructs and benchmarks for defining an item as measuring state according to the SCI. In Medvedev et al.'s (2017) study which looked at applying G-theory to distinguish between state and trait aspects of mindfulness, proposed benchmarks for state anxiety were being any item that scored SCI>0.60 as a characteristic of a state measure for state anxiety. The higher the SCI score for an item meant the more predictive this item was at measuring state characteristics of anxiety. A score of SCI=1 for example would be found to be measuring solely state aspects of anxiety and have no trait aspect present for this item (Medvedev et al., 2017).

The SCI is designed to estimate the scales sensitivity to state changes by investigating the interaction between the person and occasion which reflects the state or dynamic components of a measurement tool (Medvedev et al., 2017, 2018). The SCI also affects trait scores as it identifies the ratio of how much an item is either measuring state or trait characteristics. Medvedev et al. (2017) highlights the importance of using an absolute value of variance due to person-occasion interaction to ensure correct application of the index. The SCI is recommended to use with the STAI as it is developed in line with G-theory logic and is easy to interpret. The use of the SCI being derived from G-theory analysis of the STAI, is essential in helping to determine the distinction between items that are truly measuring state or trait anxiety. This distinction through the SCI scores benefits the diagnosis and treatment of anxiety as it helps guide treatment plans depending on whether a person is presenting with state or trait anxiety.

In an innovative study conducted by Medvedev et al. (2017), G-theory was used for the first time to evaluate state and trait components in a measure of state mindfulness, the Toronto Mindfulness Scale (TMS) (Lau et al., 2006b). In this study, the TMS was implemented over three different occasions, after a holiday, immediately after a mindfulness exercise and before a stressful event (exam). Using G-theory it was expected that the TMS would be more effective at measuring state mindfulness than trait mindfulness. The TMS measures two dimensions of state mindfulness, curiosity and decentering, and is not aimed at measuring trait mindfulness which G-theory analysis proved (Medvedev et al., 2017).

With the SCI to help analyse findings, the SCI scores were used to determine that G-theory can be and was successfully used to distinguish between state and trait components in a measure. The study found that with SCI scores for curiosity and decentering at, 0.70 and 0.75, respectively, it was concluded that the SCI scores show how the two subscales of mindfulness mainly reflect variance associated with state changes (Medvedev et al., 2017). Therefore, the TMS used two state dimensions of mindfulness and the findings are consistent with the hypothesis and expected results. In this study, G-theory analysis showed that in the G-study, the largest amount of variance for both subscales were attributable to the facets of person and occasion interaction with findings showing it was responsible for over 90% of relative and absolute error variance. These are consistent findings as person and occasion interaction is an indicator of state changes in the domains of curiosity and decentering and meet expectations for results of a measure which is supposed to measure state mindfulness (Medvedev et al., 2017).

The researchers also conducted a D-study from the G-study findings. This led them to investigate removing 2 items (4 and 7) from the decentering subscale of the TMS which did not reflect any variance attributed to a trait (person). After analysing what these findings would look like, it was found that the proportion of variance due to person-occasion interaction, decreased from 100% to 79.1%. It also showed an additional 19.8% error variance which was attributed to person and occasion interaction, with no effect on the G-coefficients. In doing this, it would threaten the reliability of the scale and it was concluded that these two items contribute to the overall reliability of the decentering subscale in discriminating between state levels (Medvedev et al., 2017). Thus, the study helps to validate G-theory as recommended methodology for differentiating between state and trait anxiety so a more accurate diagnosis of anxiety can be made.

Another study conducted by Paterson et al. (2017) used G-theory to evaluate state and trait components of depression in the Children's Depression Inventory (CDI). Results showed the CDI-10 had satisfactory generalisability of scores across occasions, but limited ability to distinguish between dynamic and stable aspects of children's depression. Again, for this study a D-study was developed to see if generalisability scores could be increased and thus, decrease the amount of error variance by removing some of the items in the CDI-10 scale. The study looked at removing two items from the 10-item scale (items four and seven), they had G-coefficients of 0.20, meaning that they had a higher sensitivity to changes over time. However, even though removing these items from the scale resulted in a decrease of the error variance explained by person and occasion interaction to 64.8%, it also decreased the overall G-coefficient to 0.72 (G-coefficient for the original G-study was 0.79) (Paterson et al., 2017). Like Medvedev et al.'s (2017) study, that although these items show low G-coefficients in the analysis stage, the items are contributing to the overall reliability of the measure. This shows that by using G-theory the study findings were able to suggest what existing measures of the CDI-10 are most suitable for measuring state and trait aspects of depression.

Therefore, distinction between state and trait anxiety first became apparent when studies showed a clear distinction between state and trait aspects of anxiety would benefit in assessment of a condition. This meant clinicians would be able to better assess state and trait symptoms and these changes over time by giving the best diagnosis and treatment at the initial time period (Paterson et al., 2017). Thus, the importance placed on accurately distinguishing between state and trait anxiety allows for more accurate diagnosis, treatment and interventions of anxiety.

Summary and Aim of the Present Work

To conclude, G-theory enables more accurate estimates of reliability, as its methodology permits a clear distinction between state and trait aspects, whilst evaluating all major sources of error affecting measurement (Medvedev et al., 2018). G-theory also derives a SCI that shows how much a scale/item represents state versus trait characteristics. A higher SCI score implies the item is more likely to be sensitive to state changes (Medvedev et al., 2017).

G-theory's multifaceted approach is a significant advantage over traditional methodologies, it has its strengths in partitioning sources of error variance, so the researcher knows where the error variance is attributed. It also enables the researcher to modify scales and questionnaires to further improve reliability and G-scores by a D-study. It allows for the incorporation and analysis of SCI and TCI scores to results, and has the underpinnings of ANOVA incorporated into it, so it can effectively determine state and trait aspects of a condition. It is fundamental methodology to use in differentiating between state and trait aspects and the above-mentioned studies on depression and mindfulness demonstrate and support the use of G-theory for making this distinction. Test-retest reliability correlation coefficients are not accounting for important sources of error associated with individual items, occasions and interactions between them and the object of measurement. Therefore, G-theory based method is more reliable and accurate in assessing state and trait anxiety of a measure, compared to test-retest reliability (Medvedev et al., 2017, 2018). Without appropriate methodology to adequately assess the reliability of an anxiety measure, it cannot be determined whether differences in scores over time are a result of ‘true’ error or chance error due to a change in test conditions or facets (March et al., 1999).

Accurate distinction between state and trait anxiety would benefit assessment as clinicians would be able to better assess and diagnose state and trait symptoms and their changes over time and give the best treatment at the initial time period (Paterson et al., 2017). In the present study, G-theory was applied to examine the distinction between state and trait anxiety items in the STAI. Therefore, G-theory is suggested as a more appropriate and reliable method to differentiate between state and trait aspects of anxiety as it considers error variance of facets. G-theory evaluates the dependability of behavioural measurements and determines the reliability of measures under specific conditions. It is an expansion of CTT, where it estimates multiple sources of measurement error, provides reliability (generalisability) coefficients and isolates major sources of error, so a more efficient measurement design can be developed (Shavelson et al., 1989; Shavelson & Webb, 2005).

Chapter 4 Generalisability Study Method and Results

The Purpose of the Study

Anxiety can be caused by having a perceived lack of competence to combat a real or perceived threat (Lazarus, 1991; Spielberger, 2010). Anxiety is prevalent in the student population as they commonly worry over academic performance and pressure to succeed (Beiter et al., 2015; Regehr et al., 2013). Early detection permits intervention before anxiety becomes a stable and chronic condition of trait anxiety. A clearer distinction between state and trait permits more accurate assessment of anxiety for measuring the effectiveness of treatments for individuals over time. The aim of the current study was to apply G-theory to distinguish between state and trait and to evaluate sources of measurement error in the widely used anxiety measure the STAI.

Participants

The total sample includes 139 New Zealand University students who completed the study questionnaire on three occasions. Approximately a quarter of the participants (n=34, 24.5%) identified as male. The age of participants ranged from 18 to 47 years, and most of the sample were of European origin. Demographic information of the study sample is represented in Table 2, including age, sex, and ethnicity of the total sample and the two subsamples. One subsample (n=83) was used for the original study and findings were replicated with another subsample (n=56) under different conditions. There were no significant differences between subsamples by age, sex, or ethnicity as evidenced by chi square test and t-test (Table 2). Power analysis was conducted based on the Intraclass Correlation Coefficient (ICC) compatible with G-theory (McGraw, & Wong, 1996). To achieve power of β=0.90, p=.05 with ICC $\geq$.40 and the repeated measures over three time points the minimum required sample size is *n*=50. Each subsample exceeded this requirement and was adequate for a reliability study in medical research (Shoukri et al., 2004).

Table 2

Demographic data of the current sample who completed STAI on three occasions

Demographics	Total n = 139	Original n = 83	Replication n = 56	Test of difference
Mean Age (SD)	22.39 (6.08)	21.34 (5.83)	23.39 (6.28)	*t*-test: $p = 0.05$
Sex n (%)				
Male	34 (24.5)	22	12	
Female	105 (75.5)	61	44	X^2 test: $p = 0.47$
Ethnicity n (%)				
European	74 (53.2)	47 (57)	27 (49.1)	
Maori	13 (9.4)	9 (11)	4 (7.4)	
Pasifika	13 (9.4)	8 (10)	5 (9)	
Asian	14 (10.1)	5 (6)	9 (14.5)	
Other	25 (18)	14 (17)	11 (20)	X^2 test: $p = 0.35$

Note: *t*-test (independent sample *t*-test); X^2 (chi square test).

Procedure

Potential participants were approached in lectures and invited to complete the questionnaire on three different occasions separated by time intervals averaging two weeks in length. All participants took part in the study on a voluntary basis. Data was collected on three different occasions over the university semester to capture variability of state anxiety. To ensure anonymity, participants were asked to include a unique personal code with three letters and three numbers to match their data across occasions. The larger subsample (*n*=83) did not involve any experimental manipulation. The smaller replication subsample data (*n*=56) were collected at specific (manipulated) occasions: straight after a university break, immediately after a 10-minute guided mindfulness exercise, and before a stressful event (important class test). Participants in both samples were instructed to return the completed forms to the researcher or submit them to a locked collection box at their faculty or use a self-addressed pre-paid envelope to post their completed forms to the researcher's university address. This study was approved by the Psychology Research and Ethics Committee, University of Waikato, ethics approval application number 19:26, which follows internationally recognised ethical standards (see Appendix A).

Measure (STAI)

The STAI is a 40-item questionnaire that includes 20-items that are supposed to assess state and 20-items that are supposed to assess trait anxiety (Spielberger, 1983). Spielberger's most updated STAI version, Form Y, was used for this research. For the state subscale of STAI, the Likert scale range is from 1 to 4 ("not at all" to "very much so"), and participants are to respond to these questions in terms of how "they feel right now/in this moment." For the trait subscale of STAI, the Likert scale also ranges from 1-

4; with response options “almost never” to “almost always”, and participants are to respond to these questions in terms of how they “generally feel.” The questionnaire is completed by participants on a self-report basis, and higher scores reflect higher levels of anxiety (Spielberger, 2012). Prior to data analysis, 19 negatively worded questions needed to be reverse coded. The total scores for state and trait subscales are calculated by adding individual subscale item scores together.

Data Analysis

Missing data comprised only four data points, which is negligible (<0.01%), and these were imputed using person mean substitution (Huisman, 2000; Paterson et al., 2017). Descriptive statistics were computed using IBM SPSSv25. A G-analysis was carried out following guidelines described elsewhere (see Appendix C1-56 and Appendix D1-50) (Cardinet et al., 2010; Medvedev et al., 2017) using EduG 6.1-e software. In following these guidelines, a random effects repeated-measures design was used for both G-study and D-study: person (P) by item (I) by occasion (O), expressed as P x I x O, where the P and O facets are infinite and the I facet is fixed. The person was a facet of differentiation, which is the object of measurement and not a source of error, while item and occasion were instrument facets (Cardinet et al., 2010). It can be presumed that error variance due to a P x O interaction in a scale score, reflects the state component of anxiety (Medvedev et al., 2017). The effects for all facets were presented by observed scores X, which were calculated by the G-study together with related variance components using formulas presented in Supplementary Table S1 (Shavelson et al., 1989).

Estimated variance components were observed in all the effects, which are possible sources of error that might impact measurement. The below formulae show how these were calculated: Estimated variance components are seen in all the effects, which are possible sources of error that might impact measurement. Generalisability analysis estimates reliability of measurements using relative G-coefficient (Gr) and absolute G-coefficient (Ga) for the object of measurement (person). G_r accounts for variance that is directly related to the object of measurement which may influence a relative measurement (e.g., person x occasion and person x item interactions) (Shavelson et al. 1989):

$$G_r = \frac{\sigma_p^2}{\sigma_p^2 + \sigma_\delta^2} ; \sigma_\delta^2 = \frac{\sigma_{pi}^2}{n_i} + \frac{\sigma_{po}^2}{n_o} + \frac{\sigma_{pio}^2}{n_i n_o};$$

Where n_i = number of items, n_o = number of ocassions.

G_a accounts for the absolute error variance ($\sigma^2\Delta = \frac{\sigma_o^2}{n_o} + \frac{\sigma_i^2}{n_i} + \frac{\sigma_{pi}^2}{n_i} + \frac{\sigma_{po}^2}{n_o} + \frac{\sigma_{io}^2}{n_i n_o} + \frac{\sigma_{pio}^2}{n_i n_o}$), which includes item and occasion interaction which may influence an absolute measure indirectly (Cardinet et al., 2010). It is equivalent to the Phi (Φ) coefficient which was obtained after applying Wimberley's correction.

$$G_a \simeq \Phi = \frac{\sigma_p^2}{\sigma_p^2 + \sigma_\Delta^2}$$

Both G_r and G_a assess the reliability of a trait measure, when the object of measurement is a person. $G_r > 0.80$ reflects good reliability of assessment scores (Cardinal et al., 2010), and coefficients for $G_a > 0.7$ are also considered reliable in some studies (Arterberry et al., 2014; Truong et al., 2020).

A SCI and TCI were obtained, which reflect the proportion of variance attributed to state and trait component in a measure. The formulae used were developed by Medvedev et al. (2017a):

$$SCI = \frac{\sigma_{po}^2}{\sigma_{po}^2 + \sigma_p^2}\ ;\ TCI = \frac{\sigma_p^2}{\sigma_{po}^2 + \sigma_p^2}$$

Where the SCI and TCI coefficients are >0.50 and <0.50 respectively, this indicates the variance is more state than trait. SCI and TCI of 0.50 means that an equal amount of variance is caused by both state and trait variance, whereas suggested coefficients of SCI > 0.60 and TCI < 0.40, for example, indicate that the variance is more a state than trait component. Conversely, where TCI > 0.60 and SCI < 0.40 for example, show the variance is reflecting more trait variance (Medvedev et al., 2017; Truong et al., 2020).

In the D-study, SCI values were calculated by applying the formula described above, and variance components were obtained for each individual item. Therefore, items that show high SCI (i.e.≥0.80) are very sensitive to changes over time and can be considered to measure state items. Where items that have a lower SCI (i.e.<0.30) are measuring trait anxiety (Medvedev et al. 2017). In the D-study, the measurement design was manipulated by adjusting the number and content of items with the aim of optimizing the measurement of state and trait anxiety.

Results

Descriptive statistics for the STAI subscales on three separate occasions are presented in Table 3, which shows the mean, standard deviation, test-retest, Cronbach's alpha, and ICC for the two samples over three occasions. When comparing the two samples, first and second (*n*=83 and *n*=56), Cronbach's alpha was higher for the larger first sample, showing stronger internal consistency across time while the second sample indicated weaker internal consistency. This was reflected in the test-retest scores being consistent with the ICC scores with the first sample also having higher test-retest scores and ICC than the second sample. For both samples the test-retest and ICC were highest for the trait subscale than the state subscale. The mean (SD) for the first sample, *n*=83 shows a significant decrease of anxiety measured by the state subscale at occasion 2, compared to the baseline at occasion 1. Whereas for the second sample *n*=56, a significant increase of anxiety measured by the state subscale over occasion 2 and 3 compared to the baseline at occasion 1 is evident.

Table 3

Descriptive statistics including; mean, standard deviation, test-retest, Cronbach's alpha, and intraclass correlation coefficient (ICC) for two study samples over 3 occasions

Scale	Occasion 1	Occasion 2	Occasion 3	ICC (95% CI)
STAI State (*n* = 83)				
Mean (SD)	41.24 (7.94)	38.84 (9.01)**	39.59 (10.47)	
Cronbach's alpha	0.85	0.90	0.83	
Test-retest (*r*)[a]	-	0.61	0.56	0.56 (0.44-0.67)
STAI Trait (*n* = 83)				
Mean (SD)	46.22 (8.06)	46.05 (8.02)	45.64 (8.72)	
Cronbach's alpha	0.84	0.85	0.88	
Test-retest (*r*)[a]	-	0.86	0.83	0.84 (0.78-0.89)
STAI State (*n* = 56)				
Mean (SD)	43.34 (6.12)	44 (4.76)*	45.52 (5.48)*	
Cronbach's alpha	0.62	0.41	0.41	
Test-retest (*r*)[a]	-	0.38	0.32	0.40 (0.23-0.56)
STAI Trait (*n* = 56)				
Mean (SD)	46.93 (6.17)	48.04 (5.20)	47.93 (5.25)	
Cronbach's alpha	0.62	0.48	0.48	
Test-retest (*r*)[a]	-	0.66	0.49	0.59 (0.44-0.72)

Note: *$p < 0.05$, **$p < 0.01$: The mean difference is statistically significant compared to occasion 1. [a]Test-retest bivariate correlations between occasion 1 and subsequent occasion 2 and 3.

G-study

G-study results for each subscale of the STAI investigated in the first sample (*n*=83) and replicated in the second sample (*n*=56) are presented in Table 4. This includes variance components for person, item and occasion and their interaction together with G-coefficients, and state and trait component indices (see Appendix C1-3 and Appendix D1-3). Results showed that both absolute and relative G-coefficients for both subscales of the STAI across both samples are ranging from 0.84 to 0.92 that would be expected for a reliable trait measure (Arterberry et al., 2014). Overall, the state subscale of STAI appeared to be more stable over time compared to the trait subscale with both samples (Table 4). Consistent with the results from the G-coefficients, TCI for both subscales were above 0.90 reflecting no sensitivity to temporal changes (state anxiety), which is also reflected by SCI below 0.10. The major sources of error in the trait subscale of STAI across both samples was the interaction between person and occasion reflecting state anxiety, followed by the interaction between person, item and occasion.

Table 4

G-study estimates for state and trait subscales of STAI with original (n = 83) and replication sample (n = 56) including standard errors (SE), Coefficient G relative (Gr), Coefficient G absolute (Ga), Trait Component Index (TCI), State Component Index (SCI), variance components (in %), and for the Person (P) × Occasion (O) × Item (I) design including interactions.

	State (n=83)		Trait (n=83)		State (n=56)		Trait (n=56)	
Facets	σ^2	%	σ^2	%	σ^2	%	σ^2	%
P	0.085		0.07		0.143		0.083	
I	0.000	1.0	0.000	0.0	0.000	0.9	0.000	0.0
O	0.002	16.6	0.001	9.2	0.002	11.3	0.001	6.5
PxI	0.002	15.6	0.002	14.6	0.004	28.4	0.003	15.6
PxO	0.005	31.4	0.004	34.4	0.003	22.7	0.007	40.7
IxO	0.001	9.4	0.001	9.4	0.001	7.1	0.001	7.7
PxIxO	0.004	26.0	0.004	32.4	0.005	29.6	0.005	29.5
SE	0.072		0.058		0.076		0.063	
Gr	**0.89**		**0.87**		**0.92**		**0.86**	
Ga	**0.85**		**0.84**		**0.90**		**0.84**	
TCI	0.94		0.95		0.98		0.92	
SCI	0.06		0.05		0.02		0.08	

Note: Numbers in bold signify acceptable reliability/generalisability coefficients

D-study

To investigate psychometrically anomalous performance of the STAI subscales that do not reflect state changes, a G-analysis was conducted for each individual STAI item (see Appendix C4-43 and Appendix D4-43). Table 5 includes variance components of person, occasion, person-occasion interaction, and the SCI for each individual item. Items extremely sensitive to state changes (with high SCI) were found in both subscales of the STAI. For instance, it was found that more items that are extremely sensitive to state changes were in the trait subscale of the STAI (e.g., 21, 25, 33, 35) with SCI above 0.88 compared to only two items showing the same state sensitivity in the state subscale of the STAI (8 & 12).

Table 5

Variance components of person, occasion, person and occasion interaction, and SCI for individual STAI items tested with original and replication samples

		P		O		PxO		SCI	
	Items	n=56	n=83	n=56	n=83	n=56	n=83	n=56	n=83
1	I feel calm	0.42	0.30	0.00	0.00	0.10	0.11	0.20	0.26
2	I feel secure	0.34	0.11	0.09	0.09	0.14	0.14	0.29	0.55
3	I am tense	0.33	0.21	0.04	0.07	0.22	0.18	0.40	0.47
4	I feel strained	0.45	0.25	0.02	0.04	0.12	0.15	0.21	0.38
5	I feel at ease	0.38	0.21	0.04	0.11	0.14	0.12	0.26	0.36
6	I feel upset	0.15	0.14	0.04	0.09	0.19	0.14	0.57	0.50
7	I am presently worrying	0.52	0.31	0.02	0.02	0.10	0.09	0.16	0.24
8	**I feel satisfied**	**0.00**	**0.00**	**0.10**	**0.14**	**0.26**	**0.23**	**1.00**	**1.00**
9	I feel frightened	0.27	0.17	0.05	0.08	0.17	0.16	0.40	0.47
10	I feel comfortable	0.40	0.22	0.02	0.02	0.12	0.12	0.23	0.36
11	I feel self-confident	0.28	0.21	0.00	0.00	0.19	0.19	0.41	0.47
12	**I feel nervous**	**0.00**	**0.00**	**0.04**	**0.05**	**0.27**	**0.21**	**1.00**	**1.00**
13	I am jittery	0.29	0.21	0.00	0.00	0.17	0.14	0.37	0.41
14	**I feel indecisive**	**0.15**	**0.08**	**0.00**	**0.00**	**0.25**	**0.18**	**0.63**	**0.69**
15	I am relaxed	0.32	0.04	0.04	0.07	0.21	0.16	0.40	0.81
16	I feel content	0.36	0.17	0.14	0.17	0.20	0.18	0.36	0.51
17	I am worried	0.39	0.24	0.01	0.01	0.16	0.14	0.28	0.38
18	I feel confused	0.34	0.21	0.01	0.01	0.14	0.12	0.29	0.36
19	I feel steady	0.68	0.30	0.01	0.01	0.13	0.14	0.16	0.32
20	I feel pleasant	0.15	0.15	0.18	0.14	0.21	0.14	0.58	0.48
21	**I feel pleasant**	**0.00**	**0.00**	**0.14**	**0.14**	**0.21**	**0.21**	**1.00**	**1.00**
22	I feel nervous and restless	0.27	0.11	0.04	0.05	0.16	0.20	0.37	0.65
23	I feel satisfied with myself	0.35	0.25	0.01	0.02	0.16	0.13	0.32	0.34
24	I wish I could be happy as others	0.18	0.13	0.00	0.01	0.19	0.19	0.51	0.59
25	**I feel like a failure**	**0.00**	**0.02**	**0.09**	**0.06**	**0.28**	**0.18**	**1.00**	**0.89**
26	I feel rested	0.27	0.24	0.00	0.00	0.19	0.16	0.41	0.40
27	**I am “calm, cool, and collected”**	**0.08**	**0.06**	**0.02**	**0.01**	**0.20**	**0.15**	**0.72**	**0.70**
28	I feel that difficulties are piling up	0.19	0.15	0.01	0.02	0.16	0.16	0.46	0.52
29	I worry too much over unimportant things	0.29	0.19	0.08	0.07	0.14	0.16	0.32	0.45
30	I am happy	0.40	0.19	0.05	0.04	0.12	0.16	0.22	0.46
31	I have disturbing thoughts	0.20	0.17	0.05	0.05	0.18	0.16	0.48	0.49
32	I lack self-confidence	0.34	0.19	0.06	0.08	0.13	0.13	0.27	0.40
33	I feel secure	0.16	0.02	0.12	0.12	0.21	0.21	0.58	0.90
34	I make decisions easily	0.18	0.27	0.01	0.01	0.18	0.12	0.50	0.30
35	**I feel inadequate**	**0.00**	**0.02**	**0.19**	**0.18**	**0.28**	**0.22**	**1.00**	**0.91**
36	I am content	0.21	0.25	0.01	0.03	0.16	0.12	0.42	0.33
37	Unimportant thoughts bother me	0.43	0.21	0.02	0.03	0.14	0.15	0.25	0.41
38	**I take disappointments keenly**	**0.00**	**0.00**	**0.00**	**0.00**	**0.29**	**0.27**	**1.00**	**1.00**
39	I am a steady person	0.19	0.22	0.04	0.04	0.17	0.10	0.47	0.31
40	I get in a state of tension	0.14	0.30	0.00	0.00	0.20	0.13	0.59	0.30

Note: Items in bold are reflecting state to the highest degree (SCI>0.60 in both samples).

In the next step, 11 of the most sensitive state items from both subscales with SCI>0.60 were combined (Medvedev et al., 2017) and estimated G-coefficient and SCI of the resulting subscale (8, 12, 14, 15, 21, 22, 25, 27, 33, 35, 38) (see Appendix C47 and Appendix D49). It was found that only four of these items were in the original state subscale of the STAI (8, 12, 14, 15). Table 6 shows the results of this analysis and indicated that absolute G-coefficient decreased substantially in value (to 0.57–0.62) compared to both original STAI subscales (0.57–0.62). However, as SCI remained too low for a reliable state measure, a series of D-analysis were conducted to derive an optimal state measure, as the second sample is a replication sample, some D-analysis was only conducted on the first sample (Table 6) (see Appendix C44-56 and Appendix D44-50). The number of items were systematically reduced by keeping the items with the highest SCI in the scale by iteratively excluding items with the lowest SCI. This was done by considering PxO interaction reflecting a state to be preferably higher for selected items. Combining the four most sensitive state items (8, 12, 21, 38) for both samples with SCI=1, and item 27 into a short five-item state scale resulted in satisfactory characteristics for a reliable state measure (Table 6, lower row in bold). This five-item state subscale displays high SCI (0.53–0.80) and lower stability over time (G-range 0.04-0.22). Combining other items displaying lower state component index were experimented with, which did not produce a better state scale.

Table 6

D-Study Reliability Estimates and Variance Components of STAI with Original (N = 83) and Replication Sample (N = 56), Including Coefficient G Relative (Gr), G Absolute (Ga), State Component Index (SCI-State), Person (P), Occasion (O) and (P X O) Interaction.

Components	Person (P)		Occasion (O)		P x O		SCI-State		Gr	Ga	Gr	Ga
Sample *n*	56	83	56	83	56	83	56	83	*n*=56		*n*=83	
Trait Anxiety Scale												
24 Items (SCI <0.50)	**0.07**	**0.06**	**0.00**	**0.00**	**0.01**	**0.00**	**0.09**	**0.05**	**0.84**	**0.83**	**0.88**	**0.87**
23 Items (SCI <0.49)	0.07	0.06	0.00	0.00	0.01	0.00	0.09	0.05	0.83	0.82	0.86	0.85
22 Items (SCI <0.48)	0.07	0.06	0.00	0.00	0.01	0.00	0.09	0.05	0.82	0.81	0.86	0.85
State Anxiety Scale												
5 Items:(SCI=1) + Item 27	**0.00**	**0.02**	**0.00**	**0.00**	**0.01**	**0.02**	**0.80**	**0.53**	**0.06**	**0.04**	**0.22**	**0.18**

Note: Scales in bold have the best characteristics of trait and state measures respectively.

To examine if a higher reliability of measuring trait anxiety can be achieved, items from the entire STAI that displayed the most robust characteristics of a trait measure were selected (see Appendix C53-56). This selection includes 24 items (1, 3, 4, 5, 7, 9, 10, 11, 13, 17, 18, 19, 20, 23, 26, 29, 30, 31, 32, 34, 36, 37, 39, and 40) with a low SCI (≦0.50) reflecting temporal stability of these items. All the remaining items had an SCI ranging between 0.50 and 0.90 and cannot be classified as measuring trait anxiety. Combining the above-mentioned 24 items together resulted in a reliable and temporary stable trait subscale, with psychometric properties only marginally enhanced compared to the original trait subscale of the STAI. Items with the highest SCI from the 24-item subscale were systematically removed, which did not yield higher temporal stability for a shorter scale (Table 6).

Chapter 5 Discussion

The aim of the present study was to apply G-theory to explore the distinction between state and trait anxiety and evaluate potential sources of measurement error in the STAI. With 78,600 Google citations the STAI is the most widely used measure for assessment of state and trait anxiety in individuals (Vitasari, 2011). The current study used two adequate independent samples, in the first sample (n = 83), there was no manipulation, and participants were not deliberately exposed to anxiety-inducing situations that may influence their state anxiety levels. The results were replicated with an independent second sample (n = 56), where state anxiety was reduced by means of a mindfulness exercise on the second occasion and increased in the context of a testing condition on the third occasion. The second sample, where the situation and mental state of participants were manipulated, is aimed at highlighting aspects of state anxiety that should be apparent across these manipulated testing conditions.

In both samples, it was consistently found that both state and trait subscales of the STAI measure trait anxiety reflected by strong temporal stability and high generalisability of scores across occasions and sample population, with G-coefficients above 0.84. Consistent with these findings, generalisability for the full 40-item STAI was even higher for both samples (G=0.92–0.93), reflecting high levels of reliability. Thus, both subscales of the STAI are stable over time, and are measuring trait anxiety evidenced by the trait index (TCI ≥ 0.92). Accordingly, the state index SCI was negligible for both subscales (0.02-0.08). Only minor amounts of variance in both the STAI subscales were attributed to the interaction between person and occasion which reflected state anxiety, followed by interaction between person, item and occasion (Truong et al., 2020). This means that the STAI fails to distinguish between state and trait aspects of anxiety, and both subscales and the total scale only reliably measure trait anxiety in the current measurement design.

Although, most of the items in both subscales of the STAI were measuring trait anxiety, the nine most dynamic aspects of state anxiety were identified in both subscales of the STAI through a D-study. The unique characteristic of these nine items was a high state index (SCI≥0.60) as measuring the state component of anxiety. These dynamic aspects of anxiety included feelings of satisfaction (8) and nervousness (12), feeling pleasant (21), restlessness (22), perceived failure (25), lack of calmness (27), feeling insecure (33), feeling inadequate (35) and sensitivity to disappointments (38). Beforehand, interventions would focus on trying to change all anxiety symptoms, state and trait, and were less effective as attempting to change trait aspects of anxiety is challenging because trait aspects are resistant to change. Now that state and trait items can be effectively distinguished through G-theory analysis, identifying items (state) that can be modified easily due to their dynamic nature should be the focus of interventions. These are very important findings because targeting these dynamic aspects of anxiety in the first place can potentially enhance effectiveness of interventions aiming to effectively reduce anxiety. Once state items of the STAI have been identified, this information and these items were used to develop a brief state scale of the STAI. Other studies discussed similar findings and suggested to derive a shorter state measure from the state subscale of the STAI (Marteau & Bekker, 1992).

These findings highlight that previously people could be accurately assessed for trait anxiety using the STAI. This indicates that previously when trying to diagnose people with anxiety from a state score of the STAI for the first 20 items it was assumed to be a temporal event that does not require attention, due to presuming that it was state anxiety as the cause for the anxiety experience. However, the current study has shown that deriving scores of anxieties from the state subscale of the STAI were more likely to be assessing trait anxiety rather than state anxiety, which should have been a focus for attention when trying to accurately diagnose anxiety. Furthermore, findings from the current study help solve the ambiguity of what items of the STAI are truly assessing state and trait anxiety by differentiating between state and trait anxiety items.

Furthermore, if reliability coefficients for state anxiety are not less than trait anxiety over time, this indicates that the methods used to analyse anxiety are unreliable and do not adequately identify a state and trait distinction. CTT estimates traditionally used to examine temporal reliability such as test-retest and ICC were inconsistent in showing lower temporal stability of the STAI subscale measuring state compared to the trait subscale. For instance, Barnes et al.'s (2002) showed higher test-retest correlations being reported for the STAI state subscale with a maximum of 0.96 and a minimum of 0.35 through test-retest reliability methods. Thus, the study supports that CTT distinction was inconsistent and misleading. These findings are consistent with other studies (Medvedev et al., 2018; Paterson et al., 2017), indicating limitations of traditional CTT methods that underestimate temporal stability of psychological measures. This is likely due to CTT methods using total scores and neither considering variability of individual items representing psychological symptoms nor accounting for specific sources of measurement error (Paterson et al., 2017). The present study highlighted the importance of evaluating temporal reliability and state and trait components of anxiety using G-theory that produces more robust estimates by considering variability of individual items and various error sources affecting psychological measurement.

In this study, combining the STAI items, which were sensitive to dynamic aspects of anxiety, to derive a sensitive measure of state anxiety, was experimented with. Then, items less sensitive to state anxiety were progressively excluded until satisfactory psychometric characteristics of a state measure were achieved. Therefore, from these dynamic STAI items, five items that were the most sensitive to dynamic aspects of anxiety and produced a sensitive measure of state anxiety were identified (8, 12, 21, 27, 38). In line with expectations for a valid state measure (SCI>0.60; G<0.70), this state scale displayed an average state index SCI of 0.67 and demonstrated low stability over time (G=0.04-0.22) (Medvedev et al., 2017). Interestingly, three of these state items including 21, 27, and 38 were from the trait subscale of the STAI while the other two, 8 and 12, were from the original state subscale. Therefore, the use of G-theory is important so a distinction can be made on what items are measuring state and trait aspects of anxiety over time, regardless of what subscale they have been categorised in originally.

Next, 24 items from both the STAI subscales with the highest trait components (SCI≦0.50) were identified and found that the overall reliability of this 24-item subscale is only marginally enhanced comparable to the original trait subscale of the STAI. This suggests that a few state items identified in the trait subscale contribute to the overall temporal stability because state items inherently include a trait component, and state variance is likely to be reduced when these items are combined with predominantly trait items (Truong et al. 2020). Overall, according to the results of the current study, unlike the state subscale, the original trait subscale of the STAI can be validated as a reliable measure for trait anxiety without needing any modifications.

One major advantage of using G-theory in this study is accounting for variability over time of the individual 40 items of the STAI and subscales necessary to determine the extent to which items/subscales are measuring state or trait anxiety (Lasater, 2007). G-theory gives a more accurate overview of the STAI as a measure for measuring state and trait anxiety over time. Medvedev et al. (2017) applied G-theory to distinguish between state and trait mindfulness using the parameter of SCI>0.60 for scales and items measuring state. In this study, the criteria of SCI=1 to select items for a sensitive state subscale was used, meaning that selected items did not reflect trait related variance at all. This is not contradictory but indicates less coherence between anxiety symptoms compared to more coherent nature of state mindfulness aspects. Even a small amount of trait-related (person) variance reflected by an item seem to affect sensitivity of the overall state scale that included several state items. For this reason, in the current study all trait-sensitive items were removed resulting in the five-item state anxiety scale contributed by this study.

Another G-theory study identified enduring post-concussion symptoms using the parameter of SCI≤0.30 and concluded that G-theory is useful for accurate evaluation of trait-like or enduring aspects of a disorder or medical condition (Medvedev, 2018). The parameters of SCI≤0.50 to identify trait items were used to derive a reliable 24-item scale to measure trait anxiety that has excellent temporal stability and generalisability of scores across occasions and a sample population. Therefore, SCI criteria for individual items are construct specific and should be determined in conjunction with assessing SCI and G-coefficients of the relevant outcome measure under development. State anxiety is a part of everyday experiences for every individual and using measures unable to separate this dynamic anxiety component can be misleading for both diagnosis and treatment of anxiety.

To date, anxiety is one of the most prevalent disorders and everyone has a different experience with anxiety depending on their perception of what is a fearful and anxiety-inducing experience (Dean, 2016). How much an anxiety-inducing experience may affect an individual is due to trait characteristics of a person. Researchers such as Buss (1989) suggest, participants who receive higher scores for each STAI subscale are likely to suffer from anxiety more than those who receive lower scores. As high state scores indicate an inclination towards a person experiencing anxiety.

It is also suggested in research that anxiety evolves from the body's fight or flight response mechanism, as anxiety engages the fight or flight response in the body, which is often presented as physical symptoms of anxiety (Ghinassi, 2018). The way the body chooses to respond to stimuli and anxiety-inducing experiences is down to several variables which include, genetics, environments, brain chemistry, life experiences and personality characteristics. The variables of brain chemistry and personality characteristics are thought to be inherited, and it is suggested that they can cause a predisposition or trait to make an individual more vulnerable to developing an anxiety disorder (Dean, 2016). If it can be determined whether the anxiety is due to state or trait factors, then the anxiety is much easier to accurately diagnose and treat. Additionally, research suggests that anxiety's physical symptoms are usually the result of a psychological condition (Haynes, 1998). Mental health disorders such as anxiety can exacerbate already present health conditions through the physical symptoms of the disorder, which is why research suggests it is significant to determine between state and trait anxiety, as trait anxiety could have negative long-term effects on a person's health.

Accordingly, it is often thought that anxiety is present with other mental health disorders such as stress and depression. This is important to note as any of these disorders can influence and trigger the onset of the other disorders. Whilst the experience and duration of stress can be short, anxiety and depression are long-term conditions, which can be made worse if stress is also a contributing factor to the anxiety or depression. Research has found that if stress is a contributing factor to anxiety, if the state condition of stress can be eliminated through successful interventions, it can then also decrease the level of state and trait anxiety experienced for a person (Mahmoud et al., 2012; Shin & Liberzon., 2010). Furthermore, it has also been found that the effects of state anxiety on the brain through emotions and feelings such as stress cause a loss of resilience in the brain pathways (Gray et al., 2014). This means that one stressful and anxiety-inducing experience can cause other situations to be stressful and anxiety-inducing due to the brain struggling to return to its normal balance and level of normal functioning after the first anxiety-inducing experience. Therefore, anxiety which could be induced due to stress, impacts on the hippocampus which is responsible for learning and memory, and the amygdala which is responsible for the fear regulation in the brain, and increases the experience of trait anxiety over time (Davis, 1997; Gray et al., 2014; Mah et al., 2015).

How in control a person feels can also affect the levels of anxiety experienced as the control factor can be dependent on and stem from their biological factors and inherited traits (Barlow, 2002). A person who feels more in control should score lower across the STAI subscales because they experience lower levels of both state and trait anxiety in a normal non-threatening situation. For example, when someone who is usually cool and calm is measured for anxiety just before an important test, and receives a high score for anxiety, it is important to be able to distinguish whether the anxiety is present due to the situation of an important test, or as a result of an anxiety disorder presenting itself. Hence, the current study explored the distinction between state and trait anxiety and found that only G-theory permits to distinguish state from trait anxiety, while simultaneously establishing the overall reliability and measurement properties of the STAI which are useful in making the state-trait distinction. Moreover, social and environmental factors also influence the presence of anxiety. Social fears that come with anxiety can be reduced through appropriate coping strategies. When adaptive coping strategies are implemented, they can be essential in helping an individual cope with their anxiety and return to a level of normal functioning in everyday situations. The earlier cognitive processes and coping strategies are learnt and implemented, the more effective they will be in helping to eliminate the anxiety that is being experienced (Legerstee et al., 2011).

Lastly, research on anxiety highlights the prevalent rates of anxiety globally, which are frequently seen in a student population (Dacey et al., 2016). The student population is found to be particularly susceptible to experiences of anxiety due to responsibilities that come with this stage of life (Bayram & Bilgel, 2008; Eisenberg et al., 2007). It has been found that students struggle with factors to do with studying, as there are inadequate support services in place to help them cope with these factors (Rawson et al., 1994). Due to the student population having high rates of anxiety, the current study and findings were conducted on and drawn from a non-clinical student population to investigate the state and trait distinction for anxiety. They are an appropriate sample population to assess the reliability of the STAI over time and to differentiate between state and trait anxiety, due to being exposed to several anxiety-inducing situations that come with being a student, such as test-anxiety.

Investigating anxiety in students who are a non-clinical sample is advantageous as a clinical population has less variability across scores, where a non-clinical population shows a large variability of scores which is necessary for G-theory to estimate variance components. A non-clinical population, such as students, are also more likely to experience both state and trait anxiety so the distinction is easier to make by assessing a non-clinical sample. For instance, anxiety disorders are linked to higher levels of trait anxiety, so those in a clinical population are more likely to be suffering from trait anxiety and experience limited levels of state anxiety, making the state-trait distinction difficult to investigate in a clinical population, making the non-clinical and student sample, more appropriate.

In summary, trait characteristics of a person are contributing factors to the onset and development of anxiety, high levels of state anxiety can increase trait anxiety through learning, and anxiety has through research been pinpointed as a severe mental health problem, as it puts pressure on the health sector, economy and disrupts normal life functioning for many who suffer from anxiety (Dean, 2016). Research also highlights how anxiety disorders are particularly problematic as trait anxiety is often enduring over a person's lifetime, even with treatment, and influences both a person's physiological and mental state. The present study, for accurate diagnosis of anxiety, found by using advanced methodology an accurate distinction between state and trait anxiety was made, which enabled the distinction between whether the anxiety is due to state or trait factors. An understanding of the biological and genetic, social, environmental, psychological, and evolutionary components of anxiety will aid in the treatment of anxiety, and whether the anxiety presented is state or trait.

Implications

The implications of these findings include estimation of an individual's risk of developing anxiety using the original trait subscale of the STAI that measures enduring symptoms of anxiety. Higher scores on these symptoms may increase likelihood to develop an anxiety-related condition. Although presenting with state anxiety is often considered normal, when a person shows high levels of trait anxiety over time, that is when anxiety becomes a problem. Trait anxiety can be used as a basic predictor of state anxiety, and studies show that more frequent experiences and higher levels of state anxiety correlates with higher levels of trait anxiety in one's characteristic (Buss, 1989;

Epstein, 1994). Thus, the more frequently an individual present with state anxiety, the more likely they are to suffer from anxiety itself (Kennedy et al., 2001; Vagg et al., 1980). Therefore, early intervention may need to focus on dynamic anxiety symptoms identified in this study that are more amendable to change.

D-study Implications

The nine items of the STAI identified through the D-study reflect dynamic symptoms of anxiety that should be the primary target of interventions to reduce anxiety, as targeting amendable symptoms will enhance effectiveness of such interventions. By reinforcing feelings that induce state anxiety an individual can turn this ‘state’ into a trait characteristic. Due to the notion that trait scores are essentially reinforced states, researchers such as Hwang et al. (2019) suggest that trait scores can be altered if interventions that focus on a person’s current state can be implemented, as trait scores can be modified through the state factor that causes them. Therefore, in line with this idea, it makes sense to target interventions towards dynamic states of anxiety that will be the most susceptible to change and influence trait anxiety.

Items 8 ‘I feel satisfied’ and item 21 ‘I feel pleasant’, which both target feelings of satisfaction, self-fulfillment, happiness and enjoyment, are the first few reverse coded dynamic aspects of anxiety identified in the STAI. As these items are reverse coded, unlike items that are not reverse coded, a high score on these items indicates less anxiety present. If a person can develop their levels of satisfaction to experience feelings of contentment and relaxation, they will be able to reduce feelings of anxiousness due to this satisfied state. Feeling satisfied and pleasant can be down to several contributing variables, including mental health, wealth, education and feelings of happiness, which are perceived by each individual differently as to how satisfied they are (Yazdanshenas Ghazwin et al., 2016).

Positive experiences and emotions that contribute to an individual's assessment of whether they feel satisfied and pleasant, can help induce coping strategies that will be more effective in reducing anxiety. Researchers, Senf and Liau (2013), believe that dynamic levels of satisfaction can be increased through positive psychology interventions where a focus is placed on positive qualities of a person to improve well-being and a more satisfied state. The intervention focuses on building on existing positive thoughts and characteristics and enhancing them to increase levels of satisfaction and happiness. This is in line with the idea that the more satisfied and pleasant an individual feels within themselves, the more they will be able to let go of things and decrease feelings of worry and uncertainty which contribute to feelings of anxiousness (Barton et al., 2014; Bystritsky et al., 2013).

Identifying feelings that contribute to a person's level of 'calmness' and relaxed state, such as item 27 'I am calm, cool, and collected', which is also reverse coded and actually assessing an individual's lack of calmness, can have a positive effect on reducing anxiety levels through this state condition. An individual who is not easily agitated and whose state of equilibrium cannot be easily unbalanced will be able to decrease their levels of trait anxiety by implementing strategies that will help them maintain a calm state in what could be anxiety-inducing situations or experiences. If for example, a person can be trained to maintain a calm state through intervention strategies such as mindfulness techniques, the feeling of calmness can become a trait for a person, and consequently have a reduced effect on trait anxiety. Mindfulness intervention strategies have been well-researched as effective strategies for reducing levels of anxiety in adults (Zoogman et al., 2015). Harris et al. (2016) implemented mindfulness and yoga-based interventions to produce a calmer state in participants by way of reducing stress levels. Being stressed and calm are contradictory states where if a person is stressed, they cannot generally be considered calm. If feelings and experiences that prevent a calm state of well-being, are reduced through interventions such as mindfulness and yoga, this can help increase feelings of calmness and aim to restore the body back to a calm state.

Next, item 33 ‘I feel secure’ is reverse coded so focuses on assessing how insecure a person feels. Increasing feelings of how secure a person feels can have a positive impact on trait anxiety by focusing on feelings and emotions that will contribute to an individual experiencing secure feelings more often. This will have positive effects on trait anxiety by way of reduction if the secure feelings can become a trait characteristic. Feelings of being secure stems from feeling safe, protected and mentally comfortable with oneself. If a focus can be placed on how safe a person feels mentally within themselves and in real situations that may typically cause anxiety, if a person can implement strategies to reinforce the ‘secure’ mindset, they may turn this mindset into a trait characteristic. Many studies identify that if a person feels safe and secure in their thoughts and feelings, they are less likely to experience anxious states (Salkovskis et al., 1991). Interventions and strategies that are suggested for increasing feelings of security are motivational self-talks, mindfulness strategies for being aware and present in the moment, and safety-seeking coping behaviours through adaptive coping strategies (Salkovskis et al., 1991; Zoogman et al., 2015).

Studies that have focused on the use of coping strategies to increase feelings of security and satisfaction to reduce anxiety have had successful results, as the more a person focuses on behaviours that enhance a positive state in a person the more likely a person is to feel confident and secure in themselves (Mahmoud et al., 2012). Overall, the above dynamic and amendable items (8, 21, 27, 33) and aspects of anxiety which are reverse coded, can have a largely positive focus for interventions. If interventions and strategies can be targeted at increasing and stabilising these dynamic positive feelings around satisfaction, contentment, pleasantness and feelings of being calm, confident and secure, there will be a greater opportunity to reduce state experiences of anxiety by successfully turning these state feelings into characteristics (trait) of a person over time and have positive effects on reducing trait anxiety (Harris et al., 2016; Zoogman et al. 2015).

Next, for items 12, 22, 25, 35, and 38 a focus needs to be placed on interventions and strategies that will aim at decreasing negative feelings associated with these states so levels of trait anxiety can be decreased. Item 12 ‘I feel nervous’, and item 22 ‘I feel nervous and restless’ target feelings of nervousness, apprehension and stress which if experienced often, can adversely affect levels of trait anxiety. Many researchers such as Powell and Enright (2015) identify intervention strategies of adaptive coping behaviour to decrease feelings which contribute to anxiety, such as nervousness and restlessness, in each situation. Suggested strategies for coping with nervous and restless feelings could be thoughts of reaffirmation, telling yourself to focus on the situation or experience, going for a walk and getting fresh air (Bystritsky et al., 2013; Powel & Enright, 2015). Other interventions that look into decreasing feelings of nervousness experiment with exposing a person to the stimuli that causes the nervous and restless feeling, so the individual can get use to the stimuli and feelings associated with it, and learn to cope with them successfully (Starlet, 2013). Feeling apprehensive, wound-up and being on edge, contributes to a person’s overall experience of nervousness.

Finally, the last amendable and dynamic state items identified through the D-study of the STAI are items 25 ‘I feel like a failure’, 35 ‘I feel inadequate’, and item 38 ‘I take disappointments keenly’. These state items focus on feelings of perceived failure, inadequacy and how sensitive a person is to disappointments. Thoughts and feelings around failure, inadequacy and disappointments contribute to the experience of state anxiety, which if focused on can lead to higher levels of trait anxiety for a person. These are negative feelings which contribute to a person experiencing state anxiety and contributing to trait anxiety levels. A person who feels like a failure, inadequate and is sensitive to disappointments, may often feel unfulfilled and that they have not reached desired expectations of achievement or hopes. Several intervention strategies are suggested for dealing with feelings of perceived failure, inadequacy and disappointments, such as, self-acceptance, positive thoughts, acceptance of situations and experience, deep-breathing, yoga, and regular exercise (Puetz et al., 2006).

A study that focused on self-acceptance to help reduce self-criticisms of oneself, saw a significant increase in self-compassion and reassurance (Shahar et al., 2012). When an individual can reassure themselves and have more feelings of self-compassion they will eliminate and reduce feelings of failure, inadequacy and disappointment. Interventions and strategies that can turn these feelings from a pessimistic outlook to an optimistic view will increase the ability of these state feelings to decrease levels of trait anxiety experienced. Therefore, self-acceptance strategies can help to decrease these dynamic state feelings to reduce levels of trait anxiety experienced.

Ultimately, as all the above nine items have been identified as state items of the STAI, they are not a permanent state of mind or being. This makes them all susceptible to change and modifiable through interventions and strategies. Learnt cognitive processes through intervention strategies can help eliminate and reduce the experience of state anxiety and thus, trait anxiety. By increasing positive feelings associated with items and states and decrease negative feelings and thoughts for items and states, through interventions, it is more likely that these state feelings can become positive trait characteristics of a person and reduce levels of trait anxiety (Legerstee et al., 2011).

Overall, in this study it has been demonstrated that the use of G-theory leads to more accurate estimation of temporal reliability of the STAI and its subscales by considering measurement error associated with individual items, occasions and their interactions with assessed individuals. This helps to overcome limitations of widely used CTT methods merely evaluating correlations between total test scores at different time points. Thus, a five-item scale to measure state anxiety based on G-theory estimates is proposed, which demonstrated high sensitivity to change of anxiety levels over time. With anxiety being one of the more common mental health disorders, relating to chronic stress, fear, and functional impairment, it is fundamental to be able to accurately distinguish between state and trait anxiety in the most effective way (Baxter et al., 2013; Leal et al., 2017).

While with the use of G-theory, findings of the present study show how the full 40-item version of the STAI and its subscales can be ambiguous as to whether they are measuring state and trait aspects of anxiety. This gives the new five-item scale measuring state anxiety and the 24-item scale to assess anxiety as a trait based on G-theory estimates, an advantage over the traditional state subscale measure of the STAI. It is the application of the recommended G-theory to measures like the STAI which help clinicians and practitioners to determine between state and trait aspects of anxiety and other mental health disorders, which helps in the assessment, diagnosis and treatment of conditions, as contextual and environmental factors diminishing or increasing anxiety in individuals can be evaluated (Baxter et al., 2013; Leal et al., 2017).

Limitations

The following limitations of this research need to be acknowledged. Firstly, the current study sample consisted entirely of participants enrolled at university. Future studies could use more diverse samples of participants including clinical populations. However, students are known to experience high levels of anxiety (e.g. test anxiety) and therefore are suitable to investigate the state-trait distinction (Gibbs, 1996). Second, the data had an overrepresentation of females. Nevertheless, studies show that anxiety is more prevalent in females and can lead to further disorders and is more debilitating for them making this disproportion quite useful (McLean et al., 2011). Rawson et al. (1994) found as well as experiencing more symptoms of depression and anxiety, females also experience more stress and anxiety in everyday environments than men. Sex differences in state-trait distinction is something that future research could explore with more balanced samples. Lastly, it needs to be remembered that when using the SCI for validation of whether an item was measuring state or trait anxiety, somewhat arbitrary cut-off points justified by the outcome reliability estimates were used.

Directions for Further Research

The literature reviewed around psychometric tools used for measuring anxiety show that most do not differentiate between state and trait subscales of anxiety. Most of the measurement tools traditionally used to measure anxiety, rely on test-retest correlations to show and validate this distinction, but these measures rarely have strong findings. As discussed earlier, the inappropriate use of test-retest scores being used to determine the distinction between state and trait anxiety from CTT scores is why there has been inconsistent and weak findings in previous literature. Investigating state and trait anxiety subscales of measurement tools have rarely applied G-theory methodology to make this distinction. Accordingly, G-theory findings show that the STAI is not differentiating between the two subscales of anxiety and is only measuring trait anxiety overall and not state anxiety. It is recommended that G-theory analysis is applied in future research to examine the ability of other psychometric measures of anxiety to distinguish between state and trait constructs.

Conclusion

To conclude, findings of the present study highlight how G-theory as a psychometric method can be used to examine the state-trait distinction in assessment of affective conditions by evaluating state and trait variance components of anxiety together with sources of measurement error and their interactions. Anxiety is caused by a combination of environmental, social, psychological, biological and genetic factors and can present itself as state or trait anxiety. Tools for measuring anxiety are mostly based on self-report instruments and questionnaires and are easy to administer and score. For accurate treatment and diagnosis of anxiety, the significance to be able to distinguish accurately between state and trait anxiety components within a measure is more pertinent than ever through valid and reliable assessments.

G-theory has been used in the present study as the most effective psychometric methodology to evaluate state and trait subscales of anxiety when applied to the STAI. Findings in this study demonstrated, that although the STAI with 78,600 Google citations is the most used measure worldwide for measuring state and trait anxiety, the STAI is unreliable in measuring state anxiety. However, from the current study findings, a valid and reliable assessment of state and trait anxiety can now be achieved. The original trait subscale of the STAI can be used to reliably measure trait anxiety while the newly brief state subscale of the STAI proposed by this study can now be used for reliable assessment of state anxiety. The results of the present study found strong temporal stability and high generalisability across occasions for both subscales and even higher for the full 40-items of the STAI combined, and thus reflects high levels of reliability. After conducting a D-study analysis dynamic aspects of anxiety; satisfaction, nervousness, feeling pleasant, restlessness, perceived failure, lack of calmness, feeling insecure, feeling inadequate and sensitivity to disappointments, that were identified as measuring state anxiety should be the main target of future interventions as they are more amendable aspects of anxiety. Trait aspects of anxiety are resistant to change and an intervention focusing on trait aspects less likely will be effective to reduce anxiety for a person, whereas targeting amendable state aspects may enhance effectiveness of such intervention.

Finally, this study through D-study analysis, using SCI parameters, constructed a brief five-item measure for assessing solely state anxiety from the most dynamic items throughout both subscales which were identified as measuring state anxiety. Thus, due to the shorter nature of this proposed questionnaire, clinicians and practitioners could benefit from using these five items to reliably and quickly assess state anxiety. Once state and trait anxiety have been reliably distinguished from one another, appropriate treatment plans can be implemented after more accurate diagnosis of anxiety has been made. Hence, the importance that is placed on being able to distinguish and differentiate between state and trait scales/items of a measure, such as the STAI, through implementation of appropriate methodology, such as G-theory.

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Supplementary Table S1.

Formulas used to estimate the effects for all facets presented by observed scores X and related variance components (Shavelson et al., 1989)

Effects

$X = \mu + X_p + X_i + X_o + X_{pi} + X_{po} + X_{io} + X_{residual}$; where μ is grand mean of X

$X_p = \mu_p - \mu$ (person effect)

$X_i = \mu_i - \mu$ (item effect)

$X_o = \mu_o - \mu$ (occasion effect)

$X_{pi} = \mu_{pi} - \mu_p - \mu_i + \mu$ (person x item effect)

$X_{po} = \mu_{po} - \mu_p - \mu_o + \mu$ (person x occasion effect)

$X_{io} = \mu_{io} - \mu_i - \mu_o + \mu$ (item x occasion effect)

$X_{residual} = X_{pio} - \mu_{pi} - \mu_{po} - \mu_{io} + \mu_p + \mu_i + \mu_o - \mu$

Variance components

Person variance component: $\sigma^2_p = (MS_p - MS_{pi} - MS_{po} + MS_{pio}) / n_i n_o$

Item variance component: $\sigma^2_i = (MS_i - MS_{pi} - MS_{io} + MS_{pio}) / n_p n_o$

Occasion variance component: $\sigma^2_o = (MS_o - MS_{io} - MS_{po} + MS_{pio}) / n_i n_p$

Person x Item variance component: $\sigma^2_{pi} = (MS_{pi} - MS_{pio}) / n_o$

Person x Occasion variance component: $\sigma^2_{po} = (MS_{po} - MS_{pio}) / n_i$

Item x Occasion variance component: $\sigma^2_{io} = (MS_{io} - MS_{pio}) / n_p$

Residual/ Person x Item x Occasion variance component: $\sigma^2_{pio} = MS_{pio}$; where MS stands for the mean of effect square and n represents facet sample size.

Appendix A

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THE UNIVERSITY OF
WAIKATO
Te Whare Wānanga o Waikato

16 August 2019

Sarah Jane Forrest
C/- School of Psychology
University of Waikato
Private Bag 3105
Hamilton 3240

Dear Sarah Jane,

Ethics Approval Application – # 19:26
Title: "Applying Generalisability Theory (G-Theory) to examine distinction between trait and state anxiety in the State and Trait Anxiety Inventory (STAI)"

Thank you for your ethics application submitted for approval which has been fully considered and approved by the Psychology Research and Ethics Committee.

Please note that approval is for three years.

If any modifications are required to your application, e.g., nature, content, location, procedures or personnel these will need to be submitted to the Convenor of the Committee.

I wish you success with your research.

Yours sincerely

Dr Tim Edwards
Convenor
Psychology Research and Ethics Committee
School of Psychology
University of Waikato

Appendix B

SELF-EVALUATION QUESTIONNAIRE STAI Form Y-1

Please provide the following information:

Name________________________________Date______________S_____

Age__________________ Gender (*Circle*) **M** **F** T_____

DIRECTIONS:

A number of statements which people have used to describe themselves are given below. Read each statement and then circle the appropriate number to the right of the statement to indicate how you feel *right* now, that is, *at this moment*. There are no right or wrong answers. Do not spend too much time on any one statement but give the answer which seems to describe your present feelings best.

	NOT AT ALL	SOMEWHAT	MODERATELY SO	VERY MUCH SO
1. I feel calm	1	2	3	4
2. I feel secure	1	2	3	4
3. I am tense	1	2	3	4
4. I feel strained	1	2	3	4
5. I feel at ease	1	2	3	4
6. I feel upset	1	2	3	4
7. I am presently worrying over possible misfortunes	1	2	3	4
8. I feel satisfied	1	2	3	4
9. I feel frightened	1	2	3	4
10. I feel comfortable	1	2	3	4
11. I feel self-confident	1	2	3	4
12. I feel nervous	1	2	3	4
13. I am jittery	1	2	3	4
14. I feel indecisive	1	2	3	4
15. I am relaxed	1	2	3	4
16. I feel content	1	2	3	4
17. I am worried	1	2	3	4
18. I feel confused	1	2	3	4
19. I feel steady	1	2	3	4
20. I feel pleasant	1	2	3	4

Appendix B

SELF-EVALUATION QUESTIONNAIRE

STAI Form Y-2

Name____Date__________

DIRECTIONS

A number of statements which people have used to describe themselves are given below. Read each statement and then circle the appropriate number to the right of the statement to indicate how you *generally* feel.

	ALMOST NEVER	SOMETIMES	OFTEN	ALMOST ALWAYS
21. I feel pleasant	1	2	3	4
22. I feel nervous and restless	1	2	3	4
23. I feel satisfied with myself	1	2	3	4
24. I wish I could be as happy as others seem to be	1	2	3	4
25. I feel like a failure	1	2	3	4
26. I feel rested	1	2	3	4
27. I am "calm, cool, and collected"	1	2	3	4
28. I feel that difficulties are piling up so that I cannot overcome them	1	2	3	4
29. I worry too much over something that really doesn't matter	1	2	3	4
30. I am happy	1	2	3	4
31. I have disturbing thoughts	1	2	3	4
32. I lack self-confidence	1	2	3	4
33. I feel secure	1	2	3	4
34. I make decisions easily	1	2	3	4
35. I feel inadequate	1	2	3	4
36. I am content	1	2	3	4
37. Some unimportant thought runs through my mind and bothers me	1	2	3	4
38. I take disappointments so keenly that I can't put them out of my mind	1	2	3	4
39. I am a steady person	1	2	3	4
40. I get in a state of tension or turmoil as I think over my recent concerns and interests	1	2	3	4

Appendix B

State-Trait Anxiety Inventory for Adults Scoring Key (Form Y-1, Y-2)

Developed by Charles D. Spielberger in collaboration with R.L. Gorsuch, R. Lushene, P.R. Vagg, and G.A. Jacobs

To use this stencil, fold this sheet in half and line up with the appropriate test side, either Form Y-1 or Form Y-2. Simply total the scoring **weights** shown on the stencil for each response category. For example, for question # 1, if the respondent marked 3, then the **weight** would be **2**. Refer to the manual for appropriate normative data.

Form Y-1	NOT AT ALL	SOMEWHAT	MODERATELY SO	VERY MUCH SO
1.	4	3	2	1
2.	4	3	2	1
3.	1	2	3	4
4.	1	2	3	4
5.	4	3	2	1
6.	1	2	3	4
7.	1	2	3	4
8.	4	3	2	1
9.	1	2	3	4
10.	4	3	2	1
11.	4	3	2	1
12.	1	2	3	4
13.	1	2	3	4
14.	1	2	3	4
15.	4	3	2	1
16.	4	3	2	1
17.	1	2	3	4
18.	1	2	3	4
19.	4	3	2	1
20.	4	3	2	1

Form Y-2	ALMOST NEVER	SOMETIMES	OFTEN	ALMOST ALWAYS
21.	4	3	2	1
22.	1	2	3	4
23.	4	3	2	1
24.	1	2	3	4
25.	1	2	3	4
26.	4	3	2	1
27.	4	3	2	1
28.	1	2	3	4
29.	1	2	3	4
30.	4	3	2	1
31.	1	2	3	4
32.	1	2	3	4
33.	4	3	2	1
34.	4	3	2	1
35.	1	2	3	4
36.	4	3	2	1
37.	1	2	3	4
38.	1	2	3	4
39.	4	3	2	1
40.	1	2	3	4

Appendix C1

EduG analyses output for the total STAI for the first sample (*n*=83), including observations and estimation designs, ANOVA and G-study table.

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	83	INF	
Item	I	40	40	
Occasion	O	3	INF	

Analysis of variance

Source	SS	df	MS	Components: Random	Mixed	Corrected	%	SE
P	462.605	82	5.642	0.041	0.044	0.044	5.4	0.007
I	547.741	39	14.045	0.000	0.000	0.000	0.0	0.015
O	1.071	2	0.535	-0.004	0.000	0.000	0.0	0.001
PI	2647.676	3198	0.828	0.117	0.117	0.117	14.5	0.007
PO	61.713	164	0.376	-0.003	0.009	0.009	1.2	0.001
IO	1068.214	78	13.695	0.159	0.159	0.159	19.7	0.026
PIO	3055.669	6396	0.478	0.478	0.478	0.478	59.2	0.008
Total	7844.689	9959					100%	

G Study Table
(Measurement design P/IO)

Source of variance	Differentiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.044		.....		.....	
	.....	I	.....		(0.000)	0.0
	.....	O	.....		0.000	0.5
	.....	PI	(0.000)	0.0	(0.000)	0.0
	.....	PO	0.003	100.0	0.003	99.5
	.....	IO	.....		(0.000)	0.0
	.....	PIO	(0.000)	0.0	(0.000)	0.0
Sum of variances	0.044		0.003	100%	0.003	100%
Standard deviation	0.209			Relative SE: 0.056	Absolute SE: 0.056	
Coef_G relative			0.93			
Coef_G absolute			0.93			

Grand mean for levels used: 2.144
Variance error of the mean for levels used: 0.001
Standard error of the grand mean: 0.024

Appendix C2

EduG analyses output for the state subscale of the STAI for the first sample (*n*=83), including observations and estimation designs, ANOVA and G-study table.

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	83	INF	
Item	I	40	40	21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40
Occasion	O	3	INF	

Analysis of variance

Source	SS	df	MS	Components: Random	Mixed	Corrected	%	SE
P	468.968	82	5.719	0.082	0.085	0.085	10.3	0.015
I	300.420	19	15.812	0.006	0.006	0.006	0.7	0.023
O	39.290	2	19.645	0.003	0.007	0.007	0.9	0.009
PI	1133.297	1558	0.727	0.091	0.091	0.091	11.1	0.009
PO	83.444	164	0.509	0.003	0.014	0.014	1.7	0.003
IO	534.558	38	14.067	0.164	0.164	0.164	20.0	0.038
PIO	1415.376	3116	0.454	0.454	0.454	0.454	55.3	0.012
Total	3975.352	4979					100%	

G Study Table
(Measurement design P/IO)

Source of variance	Differentiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.085		.....		.....	
	.....	I	.....		0.000	1.0
	.....	O	.....		0.002	16.6
	.....	PI	0.002	21.4	0.002	15.6
	.....	PO	0.005	43.0	0.005	31.4
	.....	IO	.....		0.001	9.4
	.....	PIO	0.004	35.6	0.004	26.0
Sum of variances	0.085		0.011	100%	0.015	100%
Standard deviation	0.291			Relative SE: 0.104		Absolute SE: 0.122
Coef_G relative			0.89			
Coef_G absolute			0.85			

Grand mean for levels used: 2.087
Variance error of the mean for levels used: 0.005
Standard error of the grand mean: 0.072

Appendix C3

EduG analyses output for the trait subscale of the STAI for the first sample (*n*=83*)*, including observations and estimation designs, ANOVA and G-study table.

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	83	INF	
Item	I	40	40	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
Occasion	O	3	INF	

Analysis of variance

				Components				
Source	SS	df	MS	Random	Mixed	Corrected	%	SE
P	396.716	82	4.838	0.068	0.070	0.070	8.8	0.012
I	215.384	19	11.336	-0.005	-0.005	-0.005	0.0	0.018
O	24.791	2	12.395	0.000	0.004	0.004	0.4	0.006
PI	1111.300	1558	0.713	0.074	0.074	0.074	9.2	0.009
PO	84.243	164	0.514	0.001	0.013	0.013	1.7	0.003
IO	470.647	38	12.385	0.143	0.143	0.143	18.0	0.033
PIO	1534.320	3116	0.492	0.492	0.492	0.492	61.8	0.012
Total	3837.400	4979					100%	

G Study Table
(Measurement design P/IO)

Source of variance	Differentiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.070		.....		.....	
	.....	I	.....		(0.000)	0.0
	.....	O	.....		0.001	9.2
	.....	PI	0.002	17.9	0.002	14.6
	.....	PO	0.004	42.2	0.004	34.4
	.....	IO	.....		0.001	9.4
	.....	PIO	0.004	39.9	0.004	32.4
Sum of variances	0.070		0.011	100%	0.013	100%
Standard deviation	0.265			Relative SE: 0.103	Absolute SE: 0.114	
Coef_G relative			0.87			
Coef_G absolute			0.84			

Grand mean for levels used: 2.200
Variance error of the mean for levels used: 0.003
Standard error of the grand mean: 0.058

Appendix C4

EduG analyses output for Item 1 of the STAI for the first sample (n=83), including observations and estimation designs, ANOVA and G-study table.

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	83	INF	
Item	I	40	40	2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40
Occasion	O	3	INF	

Analysis of variance

Source	SS	df	MS	Components Random	Mixed	Corrected	%	SE
P	100.032	82	1.220	0.300	0.300	0.300	47.7	0.064
I	.....	.....	.....	.....	.....	.....	.....	.....
O	2.193	2	1.096	0.009	0.009	0.009	1.5	0.009
PI	.....	.....	.....	.....	.....	.....	.....	.....
PO	52.474	164	0.320	0.320	0.320	0.320	50.8	0.035
IO	.....	.....	.....	.....	.....	.....	.....	.....
PIO	.....	.....	.....	.....	.....	.....	.....	.....
Total	154.699	248					100%	

G Study Table
(Measurement design P/IO)

Source of variance	Differentiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.070		.....		.....	
	.....	I	.....		(0.000)	0.0
	.....	O	.....		0.001	9.2
	.....	PI	0.002	17.9	0.002	14.6
	.....	PO	0.004	42.2	0.004	34.4
	.....	IO	.....		0.001	9.4
	.....	PIO	0.004	39.9	0.004	32.4
Sum of variances	0.070		0.011	100%	0.013	100%
Standard deviation	0.265			Relative SE: 0.103		Absolute SE: 0.114
Coef_G relative			0.87			
Coef_G absolute			0.84			

Grand mean for levels used: 2.200
Variance error of the mean for levels used: 0.003
Standard error of the grand mean: 0.058

Appendix C5

EduG analyses output for Item 2 of the STAI for the first sample (*n*=83), including observations and estimation designs, ANOVA and G-study table.

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	83	INF	
Item	I	40	40	1 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40
Occasion	O	3	INF	

Analysis of variance

Source	SS	df	MS	Components: Random	Mixed	Corrected	%	SE
P	62.305	82	1.205	0.247	0.247	0.247	29.8	0.064
I	.....	.....	.....	.....	.....	.....	.....	.....
O	45.839	2	10.329	0.119	0.119	0.119	14.3	0.088
PI	.....	.....	.....	.....	.....	.....	.....	.....
PO	68.827	164	0.463	0.463	0.463	0.463	55.9	0.051
IO	.....	.....	.....	.....	.....	.....	.....	.....
PIO	.....	.....	.....	.....	.....	.....	.....	.....
Total	176.972	248					100%	

G Study Table
(Measurement design P/IO)

Source of variance	Differentiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.113		.....		.....	
	.....	I	.....		.....	
	.....	O	.....		0.090	39.2
	.....	PI	.....		.....	
	.....	PO	0.140	100.0	0.140	60.8
	.....	IO	.....		.....	
	.....	PIO	.....		.....	
Sum of variances	0.113		0.140	100%	0.230	100%
Standard deviation	0.337			Relative SE: 0.374		Absolute SE: 0.480
Coef_G relative			0.45			
Coef_G absolute			0.33			

Grand mean for levels used: 1.731
Variance error of the mean for levels used: 0.093
Standard error of the grand mean: 0.306

Appendix C6

EduG analyses output for Item 3 of the STAI for the first sample (*n*=83*)*, including observations and estimation designs, ANOVA and G-study table.

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	83	INF	
Item	I	40	40	1 2 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40
Occasion	O	3	INF	

Analysis of variance

				Components				
Source	SS	df	MS	Random	Mixed	Corrected	%	SE
P	94.908	82	1.157	0.205	0.205	0.205	21.2	0.063
I	.....	.....	.....	.....	.....	.....	.....	.....
O	37.839	2	18.920	0.221	0.221	0.221	22.9	0.161
PI	.....	.....	.....	.....	.....	.....	.....	.....
PO	88.827	164	0.542	0.542	0.542	0.542	55.9	0.059
IO	.....	.....	.....	.....	.....	.....	.....	.....
PIO	.....	.....	.....	.....	.....	.....	.....	.....
Total	221.574	248					100%	

G Study Table
(Measurement design P/IO)

Source of variance	Differentiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.205		.....		.....	
	.....	I	.....		.....	
	.....	O	.....		0.074	29.0
	.....	PI	.....		.....	
	.....	PO	0.181	100.0	0.181	71.0
	.....	IO	.....		.....	
	.....	PIO	.....		.....	
Sum of variances	0.205		0.181	100%	0.254	100%
Standard deviation	0.453			Relative SE: 0.425		Absolute SE: 0.504
Coef_G relative			0.53			
Coef_G absolute			0.45			

Grand mean for levels used: 2.161
Variance error of the mean for levels used: 0.078
Standard error of the grand mean: 0.280

Appendix C7

EduG analyses output for Item 4 of the STAI for the first sample (*n*=83*)*, including observations and estimation designs, ANOVA and G-study table.

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	83	INF	
Item	I	40	40	1 2 3 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40
Occasion	O	3	INF	

Analysis of variance

Source	SS	df	MS	Components: Random	Mixed	Corrected	%	SE
P	98.835	82	1.205	0.247	0.247	0.247	29.8	0.064
I	..	.....	.....	.....	.....	.....	.....	.....
O	20.659	2	10.329	0.119	0.119	0.119	14.3	0.088
PI	..	.....	.....	.....	.....	.....	.....	.....
PO	76.008	164	0.463	0.463	0.463	0.463	55.9	0.051
IO	..	.....	.....	.....	.....	.....	.....	.....
PIO	..	.....	.....	.....	.....	.....	.....	.....
Total	195.502	248					100%	

G Study Table
(Measurement design P/IO)

Source of variance	Differentiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.247		.....		.....	
	.....	I	.....		.....	
	.....	O	.....		0.040	20.4
	.....	PI	.....		.....	
	.....	PO	0.154	100.0	0.154	79.6
	.....	IO	.....		.....	
	.....	PIO	.....		.....	
Sum of variances	0.247		0.154	100%	0.194	100%
Standard deviation		0.497		Relative SE: 0.393		Absolute SE: 0.441
Coef_G relative			0.62			
Coef_G absolute			0.56			

Grand mean for levels used: 2.149
Variance error of the mean for levels used: 0.044
Standard error of the grand mean: 0.211

Appendix C8

EduG analyses output for Item 5 of the STAI for the first sample (*n*=83*)*, including observations and estimation designs, ANOVA and G-study table.

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	83	INF	
Item	I	40	40	1 2 3 4 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40
Occasion	O	3	INF	

Analysis of variance

				Components				
Source	SS	df	MS	Random	Mixed	Corrected	%	SE
P	79.727	82	0.972	0.206	0.206	0.206	23.5	0.052
I	.....	.....	.....	.....	.....	.....	.....	.....
O	53.301	2	26.651	0.317	0.317	0.317	36.1	0.227
PI	.....	.....	.....	.....	.....	.....	.....	.....
PO	58.032	164	0.354	0.354	0.354	0.354	40.4	0.039
IO	.....	.....	.....	.....	.....	.....	.....	.....
PIO	.....	.....	.....	.....	.....	.....	.....	.....
Total	191.060	248					100%	

G Study Table
(Measurement design P/IO)

Source of variance	Differentiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.206		.....		.....	
	.....	I	.....		.....	
	.....	O	.....		0.106	47.2
	.....	PI	.....		.....	
	.....	PO	0.118	100.0	0.118	52.8
	.....	IO	.....		.....	
	.....	PIO	.....		.....	
Sum of variances	0.206		0.118	100%	0.224	100%
Standard deviation		0.454		Relative SE: 0.343		Absolute SE: 0.473
Coef_G relative			0.64			
Coef_G absolute			0.48			

Grand mean for levels used: 1.747
Variance error of the mean for levels used: 0.110
Standard error of the grand mean: 0.331

Appendix C9

EduG analyses output for Item 6 of the STAI for the first sample (*n*=83*)*, including observations and estimation designs, ANOVA and G-study table.

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	83	INF	
Item	I	40	40	1 2 3 4 5 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40
Occasion	O	3	INF	

Analysis of variance

				Components				
Source	SS	df	MS	Random	Mixed	Corrected	%	SE
P	70.225	82	0.856	0.144	0.144	0.144	17.5	0.047
I	.....	.....	.....	.....	.....	.....	.....	.....
O	42.964	2	21.482	0.254	0.254	0.254	30.8	0.183
PI	.....	.....	.....	.....	.....	.....	.....	.....
PO	69.703	164	0.425	0.425	0.425	0.425	51.7	0.047
IO	.....	.....	.....	.....	.....	.....	.....	.....
PIO	.....	.....	.....	.....	.....	.....	.....	.....
Total	182.892	248					100%	

G Study Table
(Measurement design P/IO)

Source of variance	Differentiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.144		.....		.....	
	.....	I	.....		.....	
	.....	O	.....		0.085	37.4
	.....	PI	.....		.....	
	.....	PO	0.142	100.0	0.142	62.6
	.....	IO	.....		.....	
	.....	PIO	.....		.....	
Sum of variances	0.144		0.142	100%	0.226	100%
Standard deviation	0.379			Relative SE: 0.376		Absolute SE: 0.476
Coef_G relative			0.50			
Coef_G absolute			0.39			

Grand mean for levels used: 1.843
Variance error of the mean for levels used: 0.088
Standard error of the grand mean: 0.297

Appendix C10

EduG analyses output for Item 7 of the STAI for the first sample (*n*=83*)*, including observations and estimation designs, ANOVA and G-study table.

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	83	INF	
Item	I	40	40	1 2 3 4 5 6 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40
Occasion	O	3	INF	

Analysis of variance

Source	SS	df	MS	Components: Random	Mixed	Corrected	%	SE
P	98.072	82	1.196	0.305	0.305	0.305	46.9	0.062
I	.....	.....	.....	.....	.....	.....	.....	.....
O	11.237	2	5.618	0.064	0.064	0.064	9.9	0.048
PI	.....	.....	.....	.....	.....	.....	.....	.....
PO	46.096	164	0.281	0.281	0.281	0.281	43.2	0.031
IO	.....	.....	.....	.....	.....	.....	.....	.....
PIO	.....	.....	.....	.....	.....	.....	.....	.....
Total	155.406	248					100%	

G Study Table
(Measurement design P/IO)

Source of variance	Differentiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.305		.....		.....	
	.....	I	.....		.....	
	.....	O	.....		0.021	18.6
	.....	PI	.....		.....	
	.....	PO	0.094	100.0	0.094	81.4
	.....	IO	.....		.....	
	.....	PIO	.....		.....	
Sum of variances	0.305		0.094	100%	0.115	100%
Standard deviation	0.552			Relative SE: 0.306		Absolute SE: 0.339
Coef_G relative			0.76			
Coef_G absolute			0.73			

Grand mean for levels used: 2.442
Variance error of the mean for levels used: 0.026
Standard error of the grand mean: 0.162

Appendix C11

EduG analyses output for Item 8 of the STAI for the first sample (*n*=83*)*, including observations and estimation designs, ANOVA and G-study table.

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	83	INF	
Item	I	40	40	1 2 3 4 5 6 7 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40
Occasion	O	3	INF	

Analysis of variance

Source	SS	df	MS	Components: Random	Mixed	Corrected	%	SE
P	50.233	82	0.613	-0.027	-0.027	-0.027	0.0	0.040
I	.....	.....	.....	.....	.....	.....	.....	.....
O	68.972	2	34.486	0.407	0.407	0.407	37.0	0.294
PI	.....	.....	.....	.....	.....	.....	.....	.....
PO	113.695	164	0.693	0.693	0.693	0.693	63.0	0.076
IO	.....	.....	.....	.....	.....	.....	.....	.....
PIO	.....	.....	.....	.....	.....	.....	.....	.....
Total	232.900	248					100%	

G Study Table
(Measurement design P/IO)

Source of variance	Differentiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	(0.000)		.....		.....	
	.....	I	.....		.....	
	.....	O	.....		0.136	37.0
	.....	PI	.....		.....	
	.....	PO	0.231	100.0	0.231	63.0
	.....	IO	.....		.....	
	.....	PIO	.....		.....	
Sum of variances	0.000		0.231	100%	0.367	100%
Standard deviation	0.000			Relative SE: 0.481		Absolute SE: 0.606
Coef_G relative			0.00			
Coef_G absolute			0.00			

Grand mean for levels used: 2.647
Variance error of the mean for levels used: 0.138
Standard error of the grand mean: 0.372

Appendix C12

EduG analyses output for Item 9 of the STAI for the first sample (*n*=83*)*, including observations and estimation designs, ANOVA and G-study table.

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	83	INF	
Item	I	40	40	1 2 3 4 5 6 7 8 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40
Occasion	O	3	INF	

Analysis of variance

Source	SS	df	MS	Components				
				Random	Mixed	Corrected	%	SE
P	80.803	82	0.985	0.174	0.174	0.174	19.9	0.053
I	.....	.....	.....	.....	.....	.....	.....	.....
O	39.767	2	19.884	0.234	0.234	0.234	26.8	0.169
PI	.....	.....	.....	.....	.....	.....	.....	.....
PO	76.233	164	0.465	0.465	0.465	0.465	53.3	0.051
IO	.....	.....	.....	.....	.....	.....	.....	.....
PIO	.....	.....	.....	.....	.....	.....	.....	.....
Total	196.803	248					100%	

G Study Table
(Measurement design P/IO)

Source of variance	Differentiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.174		.....		.....	
	.....	I	.....		.....	
	.....	O	.....		0.078	33.5
	.....	PI	.....		.....	
	.....	PO	0.155	100.0	0.155	66.5
	.....	IO	.....		.....	
	.....	PIO	.....		.....	
Sum of variances	0.174		0.155	100%	0.233	100%
Standard deviation	0.417			Relative SE: 0.394	Absolute SE: 0.483	
Coef_G relative			0.53			
Coef_G absolute			0.43			

Grand mean for levels used: 2.305
Variance error of the mean for levels used: 0.082
Standard error of the grand mean: 0.286

Appendix C13

EduG analyses output for Item 10 of the STAI for the first sample (*n*=83*)*, including observations and estimation designs, ANOVA and G-study table.

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	83	INF	
Item	I	40	40	1 2 3 4 5 6 7 8 9 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40
Occasion	O	3	INF	

Analysis of variance

				Components				
Source	SS	df	MS	Random	Mixed	Corrected	%	SE
P	84.956	82	1.036	0.222	0.222	0.222	33.4	0.055
I	.....	.....	.....	.....	.....	.....	.....	.....
O	12.602	2	6.301	0.071	0.071	0.071	10.8	0.054
PI	.....	.....	.....	.....	.....	.....	.....	.....
PO	60.731	164	0.370	0.370	0.370	0.370	55.8	0.041
IO	.....	.....	.....	.....	.....	.....	.....	.....
PIO	.....	.....	.....	.....	.....	.....	.....	.....
Total	158.2	248					100%	

G Study Table
(Measurement design P/IO)

Source of variance	Differentiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.222		.....		.....	
	.....	I	.....		.....	
	.....	O	.....		0.024	16.2
	.....	PI	.....		.....	
	.....	PO	0.123	100.0	0.123	83.8
	.....	IO	.....		.....	
	.....	PIO	.....		.....	
Sum of variances	0.222		0.123	100%	0.147	100%
Standard deviation		0.471		Relative SE: 0.351		Absolute SE: 0.384
Coef_G relative			0.64			
Coef_G absolute			0.60			

Grand mean for levels used: 2.217
Variance error of the mean for levels used: 0.028
Standard error of the grand mean: 0.167

Appendix C14

EduG analyses output for Item 11 of the STAI for the first sample (*n*=83*)*, including observations and estimation designs, ANOVA and G-study table.

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	83	INF	
Item	I	40	40	1 2 3 4 5 6 7 8 9 10 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40
Occasion	O	3	INF	

Analysis of variance

				Components				
Source	SS	df	MS	Random	Mixed	Corrected	%	SE
P	97.020	82	1.183	0.207	0.207	0.207	26.8	0.064
I	.....	.....	.....	.....	.....	.....	.....	.....
O	1.936	2	0.968	0.005	0.005	0.005	0.6	0.008
PI	.....	.....	.....	.....	.....	.....	.....	.....
PO	92.064	164	0.561	0.561	0.561	0.561	72.6	0.062
IO	.....	.....	.....	.....	.....	.....	.....	.....
PIO	.....	.....	.....	.....	.....	.....	.....	.....
Total	191.020	248					100%	

G Study Table
(Measurement design P/IO)

Source of variance	Differentiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.207		.....		.....	
	.....	I	.....		.....	
	.....	O	.....		0.002	0.9
	.....	PI	.....		.....	
	.....	PO	0.187	100.0	0.187	99.1
	.....	IO	.....		.....	
	.....	PIO	.....		.....	
Sum of variances	0.207		0.187	100%	0.189	100%
Standard deviation	0.455			Relative SE: 0.433		Absolute SE: 0.434
Coef_G relative			0.53			
Coef_G absolute			0.52			

Grand mean for levels used: 2.237
Variance error of the mean for levels used: 0.006
Standard error of the grand mean: 0.080

Appendix C15

EduG analyses output for Item 12 of the STAI for the first sample (*n*=83*)*, including observations and estimation designs, ANOVA and G-study table.

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	83	INF	
Item	I	40	40	1 2 3 4 5 6 7 8 9 10 11 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40
Occasion	O	3	INF	

Analysis of variance

				Components				
Source	SS	df	MS	Random	Mixed	Corrected	%	SE
P	47.285	82	0.577	-0.018	-0.018	-0.018	0.0	0.038
I	.....	.....	.....	.....	.....	.....	.....	.....
O	26.369	2	13.185	0.151	0.151	0.151	19.3	0.112
PI	.....	.....	.....	.....	.....	.....	.....	.....
PO	103.631	164	0.632	0.632	0.632	0.632	80.7	0.069
IO	.....	.....	.....	.....	.....	.....	.....	.....
PIO	.....	.....	.....	.....	.....	.....	.....	.....
Total	177.285	248					100%	

G Study Table
(Measurement design P/IO)

Source of variance	Differentiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	(0.000)		.....		.....	
	.....	I	.....		.....	
	.....	O	.....		0.050	19.3
	.....	PI	.....		.....	
	.....	PO	0.211	100.0	0.211	80.7
	.....	IO	.....		.....	
	.....	PIO	.....		.....	
Sum of variances	0.000		0.211	100%	0.261	100%
Standard deviation	0.000			Relative SE: 0.459	Absolute SE: 0.511	
Coef_G relative			0.00			
Coef_G absolute			0.00			

Grand mean for levels used: 2.104
Variance error of the mean for levels used: 0.053
Standard error of the grand mean: 0.230

Appendix C16

EduG analyses output for Item 13 of the STAI for the first sample (*n*=83*)*, including observations and estimation designs, ANOVA and G-study table.

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	83	INF	
Item	I	40	40	1 2 3 4 5 6 7 8 9 10 11 12 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40
Occasion	O	3	INF	

Analysis of variance

				Components				
Source	SS	df	MS	Random	Mixed	Corrected	%	SE
P	85.936	82	1.048	0.206	0.206	0.206	32.2	0.056
I	.....	.....	.....	.....	.....	.....	.....	.....
O	1.406	2	0.703	0.003	0.003	0.003	0.5	0.006
PI	.....	.....	.....	.....	.....	.....	.....	.....
PO	70.594	164	0.430	0.430	0.430	0.430	67.3	0.047
IO	.....	.....	.....	.....	.....	.....	.....	.....
PIO	.....	.....	.....	.....	.....	.....	.....	.....
Total	157.936	248					100%	

G Study Table
(Measurement design P/IO)

Source of variance	Differentiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.206		.....		.....	
	.....	I	.....		.....	
	.....	O	.....		0.001	0.8
	.....	PI	.....		.....	
	.....	PO	0.143	100.0	0.143	99.2
	.....	IO	.....		.....	
	.....	PIO	.....		.....	
Sum of variances	0.206		0.143	100%	0.145	100%
Standard deviation		0.454		Relative SE: 0.379		Absolute SE: 0.380
Coef_G relative			0.59			
Coef_G absolute			0.59			

Grand mean for levels used: 2.317
Variance error of the mean for levels used: 0.005
Standard error of the grand mean: 0.073

Appendix C17

EduG analyses output for Item 14 of the STAI for the first sample (*n*=83*)*, including observations and estimation designs, ANOVA and G-study table.

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	83	INF	
Item	I	40	40	1 2 3 4 5 6 7 8 9 10 11 12 13 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40
Occasion	O	3	INF	

Analysis of variance

				Components				
Source	SS	df	MS	Random	Mixed	Corrected	%	SE
P	65.406	82	0.798	0.083	0.083	0.083	13.0	0.046
I	.....	.....	.....	.....	.....	.....	.....	.....
O	0.458	2	0.229	-0.004	-0.004	-0.004	0.0	0.002
PI	.....	.....	.....	.....	.....	.....	.....	.....
PO	90.209	164	0.550	0.550	0.550	0.550	87.0	0.060
IO	.....	.....	.....	.....	.....	.....	.....	.....
PIO	.....	.....	.....	.....	.....	.....	.....	.....
Total	156.072	248					100%	

G Study Table
(Measurement design P/IO)

Source of variance	Differentiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.083		.....		.....	
	.....	I	.....		.....	
	.....	O	.....		(0.000)	0.0
	.....	PI	.....		.....	
	.....	PO	0.183	100.0	0.183	100.0
	.....	IO	.....		.....	
	.....	PIO	.....		.....	
Sum of variances	0.083		0.183	100%	0.183	100%
Standard deviation	0.287			Relative SE: 0.428		Absolute SE: 0.428
Coef_G relative			0.31			
Coef_G absolute			0.31			

Grand mean for levels used: 2.108
Variance error of the mean for levels used: 0.003
Standard error of the grand mean: 0.057

Appendix C18

EduG analyses output for Item 15 of the STAI for the first sample (*n*=83*)*, including observations and estimation designs, ANOVA and G-study table.

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	83	INF	
Item	I	40	40	1 2 3 4 5 6 7 8 9 10 11 12 13 14 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40
Occasion	O	3	INF	

Analysis of variance

				Components				
Source	SS	df	MS	Random	Mixed	Corrected	%	SE
P	49.157	82	0.599	0.039	0.039	0.039	5.4	0.036
I	.....	.....	.....	.....	.....	.....	.....	.....
O	34.129	2	17.064	0.200	0.200	0.200	27.7	0.145
PI	.....	.....	.....	.....	.....	.....	.....	.....
PO	79.205	164	0.483	0.483	0.483	0.483	66.9	0.053
IO	.....	.....	.....	.....	.....	.....	.....	.....
PIO	.....	.....	.....	.....	.....	.....	.....	.....
Total	162.490	248					100%	

G Study Table
(Measurement design P/IO)

Source of variance	Differentiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.039		.....		.....	
	.....	I	.....		.....	
	.....	O	.....		0.067	29.3
	.....	PI	.....		.....	
	.....	PO	0.161	100.0	0.161	70.7
	.....	IO	.....		.....	
	.....	PIO	.....		.....	
Sum of variances	0.039		0.161	100%	0.228	100%
Standard deviation	0.197			Relative SE: 0.401		Absolute SE: 0.477
Coef_G relative			0.19			
Coef_G absolute			0.15			

Grand mean for levels used: 1.900
Variance error of the mean for levels used: 0.069
Standard error of the grand mean: 0.263

Appendix C19

EduG analyses output for Item 16 of the STAI for the first sample (*n*=83*)*, including observations and estimation designs, ANOVA and G-study table.

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	83	INF	
Item	I	40	40	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40
Occasion	O	3	INF	

Analysis of variance

Source	SS	df	MS	Components: Random	Mixed	Corrected	%	SE
P	84.546	82	1.031	0.167	0.167	0.167	13.9	0.056
I	.....	.....	.....	.....	.....	.....	.....	.....
O	85.888	2	42.944	0.511	0.511	0.511	42.3	0.366
PI	.....	.....	.....	.....	.....	.....	.....	.....
PO	86.779	164	0.529	0.529	0.529	0.529	43.8	0.058
IO	.....	.....	.....	.....	.....	.....	.....	.....
PIO	.....	.....	.....	.....	.....	.....	.....	.....
Total	257.213	248					100%	

G Study Table
(Measurement design P/IO)

Source of variance	Differentiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.167		.....		.....	
	.....	I	.....		.....	
	.....	O	.....		0.170	49.1
	.....	PI	.....		.....	
	.....	PO	0.176	100.0	0.176	50.9
	.....	IO	.....		.....	
	.....	PIO	.....		.....	
Sum of variances	0.167		0.176	100%	0.347	100%
Standard deviation	0.409			Relative SE: 0.420		Absolute SE: 0.589
Coef_G relative			0.49			
Coef_G absolute			0.33			

Grand mean for levels used: 1.944
Variance error of the mean for levels used: 0.174
Standard error of the grand mean: 0.418

Appendix C20

EduG analyses output for Item 17 of the STAI for the first sample (*n*=83), including observations and estimation designs, ANOVA and G-study table.

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	83	INF	
Item	I	40	40	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40
Occasion	O	3	INF	

Analysis of variance

				Components				
Source	SS	df	MS	Random	Mixed	Corrected	%	SE
P	93.639	82	1.142	0.238	0.238	0.238	33.8	0.061
I	.....	.....	.....	.....	.....	.....	.....	.....
O	6.996	2	3.498	0.037	0.037	0.037	5.3	0.030
PI	.....	.....	.....	.....	.....	.....	.....	.....
PO	70.337	164	0.429	0.429	0.429	0.429	61.0	0.047
IO	.....	.....	.....	.....	.....	.....	.....	.....
PIO	.....	.....	.....	.....	.....	.....	.....	.....
Total	170.9	248					100%	

G Study Table
(Measurement design P/IO)

Source of variance	Differentiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.238		.....		.....	
	.....	I	.....		.....	
	.....	O	.....		0.012	7.9
	.....	PI	.....		.....	
	.....	PO	0.143	100.0	0.143	92.1
	.....	IO	.....		.....	
	.....	PIO	.....		.....	
Sum of variances	0.238		0.143	100%	0.155	100%
Standard deviation	0.488			Relative SE: 0.378		Absolute SE: 0.394
Coef_G relative			0.62			
Coef_G absolute			0.60			

Grand mean for levels used: 2.064
Variance error of the mean for levels used: 0.017
Standard error of the grand mean: 0.130

Appendix C21

EduG analyses output for Item 18 of the STAI for the first sample (*n*=83*)*, including observations and estimation designs, ANOVA and G-study table.

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	83	INF	
Item	I	40	40	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40
Occasion	O	3	INF	

Analysis of variance

Source	SS	df	MS	Components				
				Random	Mixed	Corrected	%	SE
P	79.213	82	0.966	0.207	0.207	0.207	35.7	0.051
I	.....	.....	.....	.....	.....	.....	.....	.....
O	5.454	2	2.727	0.029	0.029	0.029	4.9	0.023
PI	.....	.....	.....	.....	.....	.....	.....	.....
PO	56.546	164	0.345	0.345	0.345	0.345	59.4	0.038
IO	.....	.....	.....	.....	.....	.....	.....	.....
PIO	.....	.....	.....	.....	.....	.....	.....	.....
Total	141.213	248					100%	

G Study Table
(Measurement design P/IO)

Source of variance	Differentiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.207		.....		.....	
	.....	I	.....		.....	
	.....	O	.....		0.010	7.7
	.....	PI	.....		.....	
	.....	PO	0.115	100.0	0.115	92.3
	.....	IO	.....		.....	
	.....	PIO	.....		.....	
Sum of variances	0.207		0.115	100%	0.124	100%
Standard deviation	0.455			Relative SE: 0.339		Absolute SE: 0.353
Coef_G relative			0.64			
Coef_G absolute			0.62			

Grand mean for levels used: 1.610
Variance error of the mean for levels used: 0.013
Standard error of the grand mean: 0.116

Appendix C22

EduG analyses output for Item 19 of the STAI for the first sample (*n*=83*)*, including observations and estimation designs, ANOVA and G-study table.

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	83	INF	
Item	I	40	40	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40
Occasion	O	3	INF	

Analysis of variance

				Components				
Source	SS	df	MS	Random	Mixed	Corrected	%	SE
P	106.916	82	1.304	0.297	0.297	0.297	40.8	0.069
I	.....	.....	.....	.....	.....	.....	.....	.....
O	3.382	2	1.691	0.015	0.015	0.015	2.1	0.014
PI	.....	.....	.....	.....	.....	.....	.....	.....
PO	67.952	164	0.414	0.414	0.414	0.414	57.1	0.045
IO	.....	.....	.....	.....	.....	.....	.....	.....
PIO	.....	.....	.....	.....	.....	.....	.....	.....
Total	178.249	248					100%	

G Study Table
(Measurement design P/IO)

Source of variance	Differentiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.297		.....		.....	
	.....	I	.....		.....	
	.....	O	.....		0.005	3.6
	.....	PI	.....		.....	
	.....	PO	0.138	100.0	0.138	96.4
	.....	IO	.....		.....	
	.....	PIO	.....		.....	
Sum of variances	0.297		0.138	100%	0.143	100%
Standard deviation	0.545			Relative SE: 0.372	Absolute SE: 0.378	
Coef_G relative			0.68			
Coef_G absolute			0.67			

Grand mean for levels used: 2.165
Variance error of the mean for levels used: 0.010
Standard error of the grand mean: 0.102

Appendix C23

EduG analyses output for Item 20 of the STAI for the first sample (*n*=83*)*, including observations and estimation designs, ANOVA and G-study table.

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	83	INF	
Item	I	40	40	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40
Occasion	O	3	INF	

Analysis of variance

Source	SS	df	MS	Components: Random	Mixed	Corrected	%	SE
P	73.052	82	0.891	0.153	0.153	0.153	15.0	0.048
I	.....	.....	.....	.....	.....	.....	.....	.....
O	72.458	2	36.229	0.431	0.431	0.431	42.4	0.309
PI	.....	.....	.....	.....	.....	.....	.....	.....
PO	70.876	164	0.432	0.432	0.432	0.432	42.5	0.047
IO	.....	.....	.....	.....	.....	.....	.....	.....
PIO	.....	.....	.....	.....	.....	.....	.....	.....
Total	216.386	248					100%	

G Study Table
(Measurement design P/IO)

Source of variance	Differentiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.153		.....		.....	
	.....	I	.....		.....	
	.....	O	.....		0.144	49.9
	.....	PI	.....		.....	
	.....	PO	0.144	100.0	0.144	50.1
	.....	IO	.....		.....	
	.....	PIO	.....		.....	
Sum of variances	0.153		0.144	100%	0.288	100%
Standard deviation	0.391			Relative SE: 0.380	Absolute SE: 0.536	
Coef_G relative			0.51			
Coef_G absolute			0.35			

Grand mean for levels used: 2.120
Variance error of the mean for levels used: 0.147
Standard error of the grand mean: 0.384

Appendix C24

EduG analyses output for Item 21 of the STAI for the first sample (*n*=83*)*, including observations and estimation designs, ANOVA and G-study table.

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	83	INF	
Item	I	40	40	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40
Occasion	O	3	INF	

Analysis of variance

Source	SS	df	MS	Components				
				Random	Mixed	Corrected	%	SE
P	36.755	82	0.448	-0.057	-0.057	-0.057	0.0	0.032
I	.....	.....	.....	.....	.....	.....	.....	.....
O	68.345	2	34.173	0.404	0.404	0.404	39.5	0.291
PI	.....	.....	.....	.....	.....	.....	.....	.....
PO	101.655	164	0.620	0.620	0.620	0.620	60.5	0.068
IO	.....	.....	.....	.....	.....	.....	.....	.....
PIO	.....	.....	.....	.....	.....	.....	.....	.....
Total	206.755	248					100%	

G Study Table
(Measurement design P/IO)

Source of variance	Differentiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	(0.000)		.....		.....	
	.....	I	.....		.....	
	.....	O	.....		0.135	39.5
	.....	PI	.....		.....	
	.....	PO	0.207	100.0	0.207	60.5
	.....	IO	.....		.....	
	.....	PIO	.....		.....	
Sum of variances	0.000		0.207	100%	0.341	100%
Standard deviation	0.000			Relative SE: 0.455	Absolute SE: 0.584	
Coef_G relative			0.00			
Coef_G absolute			0.00			

Grand mean for levels used: 2.715
Variance error of the mean for levels used: 0.137
Standard error of the grand mean: 0.370

Appendix C25

EduG analyses output for Item 22 of the STAI for the first sample (*n*=83*)*, including observations and estimation designs, ANOVA and G-study table.

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	83	INF	
Item	I	40	40	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40
Occasion	O	3	INF	

Analysis of variance

				Components				
Source	SS	df	MS	Random	Mixed	Corrected	%	SE
P	74.627	82	0.910	0.105	0.105	0.105	12.2	0.052
I	.....	.....	.....	.....	.....	.....	.....	.....
O	27.574	2	13.787	0.159	0.159	0.159	18.5	0.117
PI	.....	.....	.....	.....	.....	.....	.....	.....
PO	97.759	164	0.596	0.596	0.596	0.596	69.3	0.065
IO	.....	.....	.....	.....	.....	.....	.....	.....
PIO	.....	.....	.....	.....	.....	.....	.....	.....
Total	199.960	248					100%	

G Study Table
(Measurement design P/IO)

Source of variance	Differentiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.105		.....		.....	
	.....	I	.....		.....	
	.....	O	.....		0.053	21.0
	.....	PI	.....		.....	
	.....	PO	0.199	100.0	0.199	79.0
	.....	IO	.....		.....	
	.....	PIO	.....		.....	
Sum of variances	0.105		0.199	100%	0.252	100%
Standard deviation	0.324			Relative SE: 0.446	Absolute SE: 0.502	
Coef_G relative			0.35			
Coef_G absolute			0.29			

Grand mean for levels used: 2.201
Variance error of the mean for levels used: 0.057
Standard error of the grand mean: 0.238

Appendix C26

EduG analyses output for Item 23 of the STAI for the first sample (*n*=83*)*, including observations and estimation designs, ANOVA and G-study table.

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	83	INF	
Item	I	40	40	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40
Occasion	O	3	INF	

Analysis of variance

Source	SS	df	MS	Components Random	Mixed	Corrected	%	SE
P	94.137	82	1.148	0.252	0.252	0.252	35.9	0.061
I	.....	.....	.....	.....	.....	.....	.....	.....
O	10.225	2	5.112	0.057	0.057	0.057	8.1	0.044
PI	.....	.....	.....	.....	.....	.....	.....	.....
PO	64.442	164	0.393	0.393	0.393	0.393	56.0	0.043
IO	.....	.....	.....	.....	.....	.....	.....	.....
PIO	.....	.....	.....	.....	.....	.....	.....	.....
Total	168.803	248					100%	

G Study Table
(Measurement design P/IO)

Source of variance	Differentiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.252		.....		.....	
	.....	I	.....		.....	
	.....	O	.....		0.019	12.6
	.....	PI	.....		.....	
	.....	PO	0.131	100.0	0.131	87.4
	.....	IO	.....		.....	
	.....	PIO	.....		.....	
Sum of variances	0.252		0.131	100%	0.150	100%
Standard deviation	0.502			Relative SE: 0.362		Absolute SE: 0.387
Coef_G relative			0.66			
Coef_G absolute			0.63			

Grand mean for levels used: 2.305
Variance error of the mean for levels used: 0.024
Standard error of the grand mean: 0.154

Appendix C27

EduG analyses output for Item 24 of the STAI for the first sample (*n*=83*)*, including observations and estimation designs, ANOVA and G-study table.

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	83	INF	
Item	I	40	40	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40
Occasion	O	3	INF	

Analysis of variance

Source	SS	df	MS	Components: Random	Mixed	Corrected	%	SE
P	79.502	82	0.970	0.131	0.131	0.131	17.9	0.054
I	.....	.....	.....	.....	.....	.....	.....	.....
O	5.430	2	2.715	0.026	0.026	0.026	3.5	0.023
PI	.....	.....	.....	.....	.....	.....	.....	.....
PO	94.570	164	0.577	0.577	0.577	0.577	78.6	0.063
IO	.....	.....	.....	.....	.....	.....	.....	.....
PIO	.....	.....	.....	.....	.....	.....	.....	.....
Total	179.502	248					100%	

G Study Table
(Measurement design P/IO)

Source of variance	Differentiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.131		.....		.....	
	.....	I	.....		.....	
	.....	O	.....		0.009	4.3
	.....	PI	.....		.....	
	.....	PO	0.192	100.0	0.192	95.7
	.....	IO	.....		.....	
	.....	PIO	.....		.....	
Sum of variances	0.131		0.192	100%	0.201	100%
Standard deviation		0.362		Relative SE: 0.438		Absolute SE: 0.448
Coef_G relative			0.41			
Coef_G absolute			0.39			

Grand mean for levels used: 2.149
Variance error of the mean for levels used: 0.012
Standard error of the grand mean: 0.112

Appendix C28

EduG analyses output for Item 25 of the STAI for the first sample (*n*=83*)*, including observations and estimation designs, ANOVA and G-study table.

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	83	INF	
Item	I	40	40	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40
Occasion	O	3	INF	

Analysis of variance

				Components				
Source	SS	df	MS	Random	Mixed	Corrected	%	SE
P	50.851	82	0.620	0.023	0.023	0.023	3.0	0.038
I	.....	.....	.....	.....	.....	.....	.....	.....
O	31.430	2	15.715	0.183	0.183	0.183	24.1	0.134
PI	.....	.....	.....	.....	.....	.....	.....	.....
PO	90.570	164	0.552	0.552	0.552	0.552	72.9	0.061
IO	.....	.....	.....	.....	.....	.....	.....	.....
PIO	.....	.....	.....	.....	.....	.....	.....	.....
Total	172.851	248				100%		

G Study Table
(Measurement design P/IO)

Source of variance	Differentiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.023		.....		.....	
	.....	I	.....		.....	
	.....	O	.....		0.061	24.9
	.....	PI	.....		.....	
	.....	PO	0.184	100.0	0.184	75.1
	.....	IO	.....		.....	
	.....	PIO	.....		.....	
Sum of variances	0.023		0.184	100%	0.245	100%
Standard deviation	0.150			Relative SE: 0.429		Absolute SE: 0.495
Coef_G relative			0.11			
Coef_G absolute			0.08			

Grand mean for levels used: 2.112
Variance error of the mean for levels used: 0.063
Standard error of the grand mean: 0.252

Appendix C29

EduG analyses output for Item 26 of the STAI for the first sample (*n*=83*)*, including observations and estimation designs, ANOVA and G-study table.

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	83	INF	
Item	I	40	40	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 27 28 29 30 31 32 33 34 35 36 37 38 39 40
Occasion	O	3	INF	

Analysis of variance

Source	SS	df	MS	Components Random	Mixed	Corrected	%	SE
P	99.430	82	1.213	0.242	0.242	0.242	33.2	0.065
I	.....	.....	.....	.....	.....	.....	.....	.....
O	0.104	2	0.052	-0.005	-0.005	-0.005	0.0	0.001
PI	.....	.....	.....	.....	.....	.....	.....	.....
PO	79.896	164	0.487	0.487	0.487	0.487	66.8	0.053
IO	.....	.....	.....	.....	.....	.....	.....	.....
PIO	.....	.....	.....	.....	.....	.....	.....	.....
Total	179.430	248					100%	

G Study Table
(Measurement design P/IO)

Source of variance	Differentiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.242		.....		.....	
	.....	I	.....		.....	
	.....	O	.....		(0.000)	0.0
	.....	PI	.....		.....	
	.....	PO	0.162	100.0	0.162	100.0
	.....	IO	.....		.....	
	.....	PIO	.....		.....	
Sum of variances	0.242		0.162	100%	0.162	100%
Standard deviation	0.492			Relative SE: 0.403	Absolute SE: 0.403	
Coef_G relative			0.60			
Coef_G absolute			0.60			

Grand mean for levels used: 2.273
Variance error of the mean for levels used: 0.005
Standard error of the grand mean: 0.070

Appendix C30

EduG analyses output for Item 27 of the STAI for the first sample (*n*=83), including observations and estimation designs, ANOVA and G-study table.

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	83	INF	
Item	I	40	40	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 28 29 30 31 32 33 34 35 36 37 38 39 40
Occasion	O	3	INF	

Analysis of variance

Source	SS	df	MS	Components: Random	Mixed	Corrected	%	SE
P	51.558	82	0.629	0.063	0.063	0.063	11.7	0.036
I	.....	.....	.....	.....	.....	.....	.....	.....
O	6.369	2	3.185	0.033	0.033	0.033	6.2	0.027
PI	.....	.....	.....	.....	.....	.....	.....	.....
PO	72.297	164	0.441	0.441	0.441	0.441	82.2	0.048
IO	.....	.....	.....	.....	.....	.....	.....	.....
PIO	.....	.....	.....	.....	.....	.....	.....	.....
Total	130.225	248					100%	

G Study Table
(Measurement design P/IO)

Source of variance	Differentiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.063		.....		.....	
	.....	I	.....		.....	
	.....	O	.....		0.011	7.0
	.....	PI	.....		.....	
	.....	PO	0.147	100.0	0.147	93.0
	.....	IO	.....		.....	
	.....	PIO	.....		.....	
Sum of variances	0.063		0.147	100%	0.158	100%
Standard deviation	0.250			Relative SE: 0.383		Absolute SE: 0.397
Coef_G relative			0.30			
Coef_G absolute			0.28			

Grand mean for levels used: 2.177
Variance error of the mean for levels used: 0.014
Standard error of the grand mean: 0.116

Appendix C31

EduG analyses output for Item 28 of the STAI for the first sample (*n*=83*)*, including observations and estimation designs, ANOVA and G-study table.

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	83	INF	
Item	I	40	40	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 29 30 31 32 33 34 35 36 37 38 39 40
Occasion	O	3	INF	

Analysis of variance

				Components				
Source	SS	df	MS	Random	Mixed	Corrected	%	SE
P	76.795	82	0.937	0.151	0.151	0.151	21.9	0.051
I	.....	.....	.....	.....	.....	.....	.....	.....
O	10.056	2	5.028	0.055	0.055	0.055	7.9	0.043
PI	.....	.....	.....	.....	.....	.....	.....	.....
PO	79.277	164	0.483	0.483	0.483	0.483	70.1	0.053
IO	.....	.....	.....	.....	.....	.....	.....	.....
PIO	.....	.....	.....	.....	.....	.....	.....	.....
Total	166.129	248					100%	

G Study Table
(Measurement design P/IO)

Source of variance	Differentiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.151		.....		.....	
	.....	I	.....		.....	
	.....	O	.....		0.018	10.2
	.....	PI	.....		.....	
	.....	PO	0.161	100.0	0.161	89.8
	.....	IO	.....		.....	
	.....	PIO	.....		.....	
Sum of variances	0.151		0.161	100%	0.179	100%
Standard deviation	0.389			Relative SE: 0.401	Absolute SE: 0.424	
Coef_G relative			0.48			
Coef_G absolute			0.46			

Grand mean for levels used: 1.811
Variance error of the mean for levels used: 0.022
Standard error of the grand mean: 0.148

Appendix C32

EduG analyses output for Item 29 of the STAI for the first sample (*n*=83*)*, including observations and estimation designs, ANOVA and G-study table.

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	83	INF	
Item	I	40	40	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 30 31 32 33 34 35 36 37 38 39 40
Occasion	O	3	INF	

Analysis of variance

Source	SS	df	MS	Components: Random	Mixed	Corrected	%	SE
P	85.462	82	1.042	0.192	0.192	0.192	22.3	0.056
I	.....	.....	.....	.....	.....	.....	.....	.....
O	35.084	2	17.542	0.206	0.206	0.206	23.8	0.149
PI	.....	.....	.....	.....	.....	.....	.....	.....
PO	76.249	164	0.465	0.465	0.465	0.465	53.9	0.051
IO	.....	.....	.....	.....	.....	.....	.....	.....
PIO	.....	.....	.....	.....	.....	.....	.....	.....
Total	196.795	248					100%	

G Study Table
(Measurement design P/IO)

Source of variance	Differentiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.192		.....		.....	
	.....	I	.....		.....	
	.....	O	.....		0.069	30.7
	.....	PI	.....		.....	
	.....	PO	0.155	100.0	0.155	69.3
	.....	IO	.....		.....	
	.....	PIO	.....		.....	
Sum of variances	0.192		0.155	100%	0.224	100%
Standard deviation	0.439			Relative SE: 0.394		Absolute SE: 0.473
Coef_G relative			0.55			
Coef_G absolute			0.46			

Grand mean for levels used: 1.855
Variance error of the mean for levels used: 0.073
Standard error of the grand mean: 0.270

Appendix C33

EduG analyses output for Item 30 of the STAI for the first sample (*n*=83*)*, including observations and estimation designs, ANOVA and G-study table.

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	83	INF	
Item	I	40	40	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 31 32 33 34 35 36 37 38 39 40
Occasion	O	3	INF	

Analysis of variance

				Components				
Source	SS	df	MS	Random	Mixed	Corrected	%	SE
P	85.406	82	1.042	0.186	0.186	0.186	23.2	0.056
I	.....	.....	.....	.....	.....	.....	.....	.....
O	22.659	2	11.329	0.131	0.131	0.131	16.3	0.097
PI	.....	.....	.....	.....	.....	.....	.....	.....
PO	79.341	164	0.484	0.484	0.484	0.484	60.4	0.053
IO	.....	.....	.....	.....	.....	.....	.....	.....
PIO	.....	.....	.....	.....	.....	.....	.....	.....
Total	187.406	248					100%	

G Study Table
(Measurement design P/IO)

Source of variance	Differentiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.186		.....		.....	
	.....	I	.....		.....	
	.....	O	.....		0.044	21.3
	.....	PI	.....		.....	
	.....	PO	0.161	100.0	0.161	78.7
	.....	IO	.....		.....	
	.....	PIO	.....		.....	
Sum of variances	0.186		0.161	100%	0.205	100%
Standard deviation	0.431			Relative SE: 0.402		Absolute SE: 0.453
Coef_G relative			0.54			
Coef_G absolute			0.48			

Grand mean for levels used: 2.225
Variance error of the mean for levels used: 0.048
Standard error of the grand mean: 0.218

Appendix C34

EduG analyses output for Item 31 of the STAI for the first sample (*n*=83), including observations and estimation designs, ANOVA and G-study table.

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	83	INF	
Item	I	40	40	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 32 33 34 35 36 37 38 39 40
Occasion	O	3	INF	

Analysis of variance

Source	SS	df	MS	Components				
				Random	Mixed	Corrected	%	SE
P	81.470	82	0.994	0.170	0.170	0.170	21.2	0.054
I	.....	.....	.....	.....	.....	.....	.....	.....
O	26.273	2	13.137	0.152	0.152	0.152	18.9	0.112
PI	.....	.....	.....	.....	.....	.....	.....	.....
PO	79.060	164	0.482	0.482	0.482	0.482	59.9	0.053
IO	.....	.....	.....	.....	.....	.....	.....	.....
PIO	.....	.....	.....	.....	.....	.....	.....	.....
Total	186.803	248					100%	

G Study Table
(Measurement design P/IO)

Source of variance	Differentiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.170		.....		.....	
	.....	I	.....		.....	
	.....	O	.....		0.051	24.0
	.....	PI	.....		.....	
	.....	PO	0.161	100.0	0.161	76.0
	.....	IO	.....		.....	
	.....	PIO	.....		.....	
Sum of variances	0.170		0.161	100%	0.212	100%
Standard deviation	0.413			Relative SE: 0.401	Absolute SE: 0.460	
Coef_G relative			0.51			
Coef_G absolute			0.45			

Grand mean for levels used: 1.972
Variance error of the mean for levels used: 0.055
Standard error of the grand mean: 0.234

Appendix C35

EduG analyses output for Item 32 of the STAI for the first sample (*n*=83*)*, including observations and estimation designs, ANOVA and G-study table.

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	83	INF	
Item	I	40	40	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 32 33 34 35 36 37 38 39 40
Occasion	O	3	INF	

Analysis of variance

Source	SS	df	MS	Components: Random	Mixed	Corrected	%	SE
P	81.470	82	0.994	0.170	0.170	0.170	21.2	0.054
I	.....	.....	.....	.....	.....	.....	.....	.....
O	26.273	2	13.137	0.152	0.152	0.152	18.9	0.112
PI	.....	.....	.....	.....	.....	.....	.....	.....
PO	79.060	164	0.482	0.482	0.482	0.482	59.9	0.053
IO	.....	.....	.....	.....	.....	.....	.....	.....
PIO	.....	.....	.....	.....	.....	.....	.....	.....
Total	186.803	248					100%	

G Study Table
(Measurement design P/IO)

Source of variance	Differentiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.170		.....		.....	
	.....	I	.....		.....	
	.....	O	.....		0.051	24.0
	.....	PI	.....		.....	
	.....	PO	0.161	100.0	0.161	76.0
	.....	IO	.....		.....	
	.....	PIO	.....		.....	
Sum of variances	0.170		0.161	100%	0.212	100%
Standard deviation	0.413			Relative SE: 0.401		Absolute SE: 0.460
Coef_G relative			0.51			
Coef_G absolute			0.45			

Grand mean for levels used: 1.972
Variance error of the mean for levels used: 0.055
Standard error of the grand mean: 0.234

Appendix C36

EduG analyses output for Item 33 of the STAI for the first sample (*n*=83), including observations and estimation designs, ANOVA and G-study table.

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	83	INF	
Item	I	40	40	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 34 35 36 37 38 39 40
Occasion	O	3	INF	

Analysis of variance

				Components				
Source	SS	df	MS	Random	Mixed	Corrected	%	SE
P	57.847	82	0.705	0.024	0.024	0.024	2.4	0.043
I	.....	.....	.....	.....	.....	.....	.....	.....
O	62.876	2	31.438	0.371	0.371	0.371	36.1	0.268
PI	.....	.....	.....	.....	.....	.....	.....	.....
PO	103.791	164	0.633	0.633	0.633	0.633	61.6	0.069
IO	.....	.....	.....	.....	.....	.....	.....	.....
PIO	.....	.....	.....	.....	.....	.....	.....	.....
Total	224.514	248				100%		

G Study Table
(Measurement design P/IO)

Source of variance	Differentiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.024		.....		.....	
	.....	I	.....		.....	
	.....	O	.....		0.124	37.0
	.....	PI	.....		.....	
	.....	PO	0.211	100.0	0.211	63.0
	.....	IO	.....		.....	
	.....	PIO	.....		.....	
Sum of variances	0.024		0.211	100%	0.335	100%
Standard deviation	0.156			Relative SE: 0.459	Absolute SE: 0.579	
Coef_G relative			0.10			
Coef_G absolute			0.07			

Grand mean for levels used: 1.956
Variance error of the mean for levels used: 0.127
Standard error of the grand mean: 0.356

Appendix C37

EduG analyses output for Item 34 of the STAI for the first sample (*n*=83), including observations and estimation designs, ANOVA and G-study table.

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	83	INF	
Item	I	40	40	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 35 36 37 38 39 40
Occasion	O	3	INF	

Analysis of variance

Source	SS	df	MS	Components: Random	Mixed	Corrected	%	SE
P	93.743	82	1.143	0.265	0.265	0.265	41.5	0.060
I	.....	.....	.....	.....	.....	.....	.....	.....
O	4.851	2	2.426	0.025	0.025	0.025	3.9	0.021
PI	.....	.....	.....	.....	.....	.....	.....	.....
PO	57.149	164	0.348	0.348	0.348	0.348	54.6	0.038
IO	.....	.....	.....	.....	.....	.....	.....	.....
PIO	.....	.....	.....	.....	.....	.....	.....	.....
Total	155.743	248					100%	

G Study Table
(Measurement design P/IO)

Source of variance	Differentiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.265		.....		.....	
	.....	I	.....		.....	
	.....	O	.....		0.008	6.7
	.....	PI	.....		.....	
	.....	PO	0.116	100.0	0.116	93.3
	.....	IO	.....		.....	
	.....	PIO	.....		.....	
Sum of variances	0.265		0.116	100%	0.124	100%
Standard deviation	0.515			Relative SE: 0.341	Absolute SE: 0.353	
Coef_G relative			0.70			
Coef_G absolute			0.68			

Grand mean for levels used: 2.365
Variance error of the mean for levels used: 0.013
Standard error of the grand mean: 0.114

Appendix C38

EduG analyses output for Item 35 of the STAI for the first sample (*n*=83), including observations and estimation designs, ANOVA and G-study table.

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	83	INF	
Item	I	40	40	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 36 37 38 39 40
Occasion	O	3	INF	

Analysis of variance

				Components				
Source	SS	df	MS	Random	Mixed	Corrected	%	SE
P	58.209	82	0.710	0.022	0.022	0.022	1.8	0.043
I	.....	.....	.....	.....	.....	.....	.....	.....
O	90.900	2	45.450	0.540	0.540	0.540	44.7	0.387
PI	.....	.....	.....	.....	.....	.....	.....	.....
PO	105.767	164	0.645	0.645	0.645	0.645	53.5	0.071
IO	.....	.....	.....	.....	.....	.....	.....	.....
PIO	.....	.....	.....	.....	.....	.....	.....	.....
Total	254.876	248					100%	

G Study Table
(Measurement design P/IO)

Source of variance	Differentiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.022		.....		.....	
	.....	I	.....		.....	
	.....	O	.....		0.180	45.6
	.....	PI	.....		.....	
	.....	PO	0.215	100.0	0.215	54.4
	.....	IO	.....		.....	
	.....	PIO	.....		.....	
Sum of variances	0.022		0.215	100%	0.395	100%
Standard deviation	0.147			Relative SE: 0.464		Absolute SE: 0.628
Coef_G relative			0.09			
Coef_G absolute			0.05			

Grand mean for levels used: 2.426
Variance error of the mean for levels used: 0.183
Standard error of the grand mean: 0.428

Appendix C39

EduG analyses output for Item 36 of the STAI for the first sample (*n*=83), including observations and estimation designs, ANOVA and G-study table.

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	83	INF	
Item	I	40	40	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 37 38 39 40
Occasion	O	3	INF	

Analysis of variance

Source	SS	df	MS	Components: Random	Mixed	Corrected	%	SE
P	91.390	82	1.115	0.249	0.249	0.249	34.8	0.059
I	.....	.....	.....	.....	.....	.....	.....	.....
O	17.133	2	8.566	0.099	0.099	0.099	13.8	0.073
PI	.....	.....	.....	.....	.....	.....	.....	.....
PO	60.201	164	0.367	0.367	0.367	0.367	51.3	0.040
IO	.....	.....	.....	.....	.....	.....	.....	.....
PIO	.....	.....	.....	.....	.....	.....	.....	.....
Total	168.723	248					100%	

G Study Table
(Measurement design P/IO)

Source of variance	Differentiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.249		.....		.....	
	.....	I	.....		.....	
	.....	O	.....		0.033	21.2
	.....	PI	.....		.....	
	.....	PO	0.122	100.0	0.122	78.8
	.....	IO	.....		.....	
	.....	PIO	.....		.....	
Sum of variances	0.249		0.122	100%	0.155	100%
Standard deviation	0.499			Relative SE: 0.350		Absolute SE: 0.394
Coef_G relative			0.67			
Coef_G absolute			0.62			

Grand mean for levels used: 2.422
Variance error of the mean for levels used: 0.037
Standard error of the grand mean: 0.193

Appendix C40

EduG analyses output for Item 37 of the STAI for the first sample (*n*=83), including observations and estimation designs, ANOVA and G-study table.

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	83	INF	
Item	I	40	40	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 38 39 40
Occasion	O	3	INF	

Analysis of variance

Source	SS	df	MS	Components: Random	Mixed	Corrected	%	SE
P	87.936	82	1.072	0.212	0.212	0.212	29.1	0.057
I	.....	.....	.....	.....	.....	.....	.....	.....
O	14.659	2	7.329	0.083	0.083	0.083	11.4	0.062
PI	.....	.....	.....	.....	.....	.....	.....	.....
PO	71.341	164	0.435	0.435	0.435	0.435	59.5	0.048
IO	.....	.....	.....	.....	.....	.....	.....	.....
PIO	.....	.....	.....	.....	.....	.....	.....	.....
Total	173.936	248					100%	

G Study Table
(Measurement design P/IO)

Source of variance	Differentiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.212		.....		.....	
	.....	I	.....		.....	
	.....	O	.....		0.028	16.0
	.....	PI	.....		.....	
	.....	PO	0.145	100.0	0.145	84.0
	.....	IO	.....		.....	
	.....	PIO	.....		.....	
Sum of variances	0.212		0.145	100%	0.173	100%
Standard deviation	0.461			Relative SE: 0.381		Absolute SE: 0.416
Coef_G relative			0.59			
Coef_G absolute			0.55			

Grand mean for levels used: 2.317
Variance error of the mean for levels used: 0.032
Standard error of the grand mean: 0.179

Appendix C41

EduG analyses output for Item 38 of the STAI for the first sample (*n*=83*)*, including observations and estimation designs, ANOVA and G-study table.

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	83	INF	
Item	I	40	40	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 39 40
Occasion	O	3	INF	

Analysis of variance

				Components				
Source	SS	df	MS	Random	Mixed	Corrected	%	SE
P	44.217	82	0.539	-0.091	-0.091	-0.091	0.0	0.041
I	.....	.....	.....	.....	.....	.....	.....	.....
O	1.984	2	0.992	0.002	0.002	0.002	0.3	0.009
PI	.....	.....	.....	.....	.....	.....	.....	.....
PO	133.349	164	0.813	0.813	0.813	0.813	99.7	0.089
IO	.....	.....	.....	.....	.....	.....	.....	.....
PIO	.....	.....	.....	.....	.....	.....	.....	.....
Total	179.550	248					100%	

G Study Table
(Measurement design P/IO)

Source of variance	Differentiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	(0.000)		.....		.....	
	.....	I	.....		.....	
	.....	O	.....		0.001	0.3
	.....	PI	.....		.....	
	.....	PO	0.271	100.0	0.271	99.7
	.....	IO	.....		.....	
	.....	PIO	.....		.....	
Sum of variances	0.000		0.271	100%	0.272	100%
Standard deviation	0.000			Relative SE: 0.521		Absolute SE: 0.521
Coef_G relative			0.00			
Coef_G absolute			0.00			

Grand mean for levels used: 2.257
Variance error of the mean for levels used: 0.004
Standard error of the grand mean: 0.063

Appendix C42

EduG analyses output for Item 39 of the STAI for the first sample (*n*=83), including observations and estimation designs, ANOVA and G-study table.

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	83	INF	
Item	I	40	40	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 40
Occasion	O	3	INF	

Analysis of variance

				Components				
Source	SS	df	MS	Random	Mixed	Corrected	%	SE
P	77.357	82	0.943	0.217	0.217	0.217	34.6	0.050
I	.....	.....	.....	.....	.....	.....	.....	.....
O	20.080	2	10.040	0.117	0.117	0.117	18.7	0.086
PI	.....	.....	.....	.....	.....	.....	.....	.....
PO	47.920	164	0.292	0.292	0.292	0.292	46.6	0.032
IO	.....	.....	.....	.....	.....	.....	.....	.....
PIO	.....	.....	.....	.....	.....	.....	.....	.....
Total	145.357	248					100%	

G Study Table
(Measurement design P/IO)

Source of variance	Differentiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.217		.....		.....	
	.....	I	.....		.....	
	.....	O	.....		0.039	28.7
	.....	PI	.....		.....	
	.....	PO	0.097	100.0	0.097	71.3
	.....	IO	.....		.....	
	.....	PIO	.....		.....	
Sum of variances	0.217		0.097	100%	0.137	100%
Standard deviation	0.466			Relative SE: 0.312		Absolute SE: 0.370
Coef_G relative			0.69			
Coef_G absolute			0.61			

Grand mean for levels used: 2.137
Variance error of the mean for levels used: 0.043
Standard error of the grand mean: 0.207

Appendix C43

EduG analyses output for Item 40 of the STAI for the first sample (*n*=83*)*, including observations and estimation designs, ANOVA and G-study table.

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	83	INF	
Item	I	40	40	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39
Occasion	O	3	INF	

Analysis of variance

				Components				
Source	SS	df	MS	Random	Mixed	Corrected	%	SE
P	104.137	82	1.270	0.297	0.297	0.297	43.8	0.067
I	.....	.....	.....	.....	.....	.....	.....	.....
O	0.297	2	0.149	-0.003	-0.003	-0.003	0.0	0.001
PI	.....	.....	.....	.....	.....	.....	.....	.....
PO	62.369	164	0.380	0.380	0.380	0.380	56.2	0.042
IO	.....	.....	.....	.....	.....	.....	.....	.....
PIO	.....	.....	.....	.....	.....	.....	.....	.....
Total	166.803	248					100%	

G Study Table
(Measurement design P/IO)

Source of variance	Differentiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.297		.....		.....	
	.....	I	.....		.....	
	.....	O	.....		(0.000)	0.0
	.....	PI	.....		.....	
	.....	PO	0.127	100.0	0.127	100.0
	.....	IO	.....		.....	
	.....	PIO	.....		.....	
Sum of variances	0.297		0.127	100%	0.127	100%
Standard deviation	0.545			Relative SE: 0.356		Absolute SE: 0.356
Coef_G relative			0.70			
Coef_G absolute			0.70			

Grand mean for levels used: 2.305
Variance error of the mean for levels used: 0.005
Standard error of the grand mean: 0.071

Appendix C44

EduG analyses output for the combination of the six highest State Component Index items of the STAI, for the first sample (*n*=83), from each subscale, including observations and estimation designs, ANOVA and G-study table.

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	83	INF	
Item	I	40	40	1 2 3 4 5 6 7 9 10 11 13 14 15 16 17 18 19 20 22 23 24 26 27 28 29 30 31 32 33 34 36 37 39 40
Occasion	O	3	INF	

Analysis of variance

Source	SS	df	MS	Components				
				Random	Mixed	Corrected	%	SE
P	65.228	82	0.795	0.019	0.018	0.018	1.7	0.008
I	86.622	5	17.324	-0.043	-0.043	-0.042	0.0	0.059
O	7.046	2	3.523	-0.049	-0.041	-0.041	0.0	0.024
PI	222.323	410	0.542	-0.044	-0.044	-0.044	0.0	0.017
PO	96.399	164	0.588	-0.014	0.003	0.003	0.2	0.012
IO	280.954	10	28.095	0.330	0.330	0.330	32.3	0.138
PIO	552.268	820	0.673	0.673	0.673	0.673	65.8	0.033
Total	1310.839	1493					100%	

G Study Table
(Measurement design P/IO)

Source of variance	Differentiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.018		.....		.....	
	.....	I	.....		(0.000)	0.0
	.....	O	.....		(0.000)	0.0
	.....	PI	(0.000)	0.0	(0.000)	0.0
	.....	PO	0.001	2.5	0.001	1.7
	.....	IO	.....		0.016	32.3
	.....	PIO	0.033	97.5	0.033	65.9
Sum of variances	0.018		0.033	100%	0.049	100%
Standard deviation	0.133			Relative SE: 0.183	Absolute SE: 0.222	
Coef_G relative			0.35			
Coef_G absolute			0.26			

Grand mean for levels used: 2.377
Variance error of the mean for levels used: 0.017
Standard error of the grand mean: 0.129

Appendix C45

EduG analyses output for the combination of seven items of the STAI for the first sample (*n*=83), with a high State Component Index from each subscale, including observations and estimation designs, ANOVA and G-study table.

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	83	INF	
Item	I	40	40	1 2 3 4 5 6 7 9 10 11 13 14 15 16 17 18 19 20 22 23 25 26 28 29 30 31 32 34 35 36 37 39 40
Occasion	O	3	INF	

Analysis of variance

Source	SS	df	MS	Components: Random	Mixed	Corrected	%	SE
P	89.952	82	1.097	0.018	0.017	0.017	2.0	0.009
I	121.411	6	20.235	0.006	0.006	0.006	0.7	0.050
O	14.738	2	7.369	-0.020	-0.014	-0.014	0.0	0.015
PI	277.446	492	0.564	-0.014	-0.014	-0.014	0.0	0.015
PO	125.738	164	0.767	0.023	0.038	0.038	4.3	0.013
IO	225.608	12	18.801	0.219	0.219	0.219	24.7	0.086
PIO	597.250	984	0.607	0.607	0.607	0.607	68.4	0.027
Total	1452.142	1742					100%	

G Study Table
(Measurement design P/IO)

Source of variance	Differentiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.017		.....		.....	
	.....	I	.....		0.001	1.5
	.....	O	.....		(0.000)	0.0
	.....	PI	(0.000)	0.0	(0.000)	0.0
	.....	PO	0.013	34.1	0.013	27.1
	.....	IO	.....		0.009	18.9
	.....	PIO	0.024	65.9	0.024	52.4
Sum of variances	0.017		0.37	100%	0.47	100%
Standard deviation	0.132			Relative SE: 0.193	Absolute SE: 0.216	
Coef_G relative			0.32			
Coef_G absolute			0.27			

Grand mean for levels used: 2.286
Variance error of the mean for levels used: 0.010
Standard error of the grand mean: 0.101

Appendix C46

EduG analyses output for the combination of the eight highest State Component Index items of the STAI, for the first sample (*n*=83*)*, from each subscale, including observations and estimation designs, ANOVA and G-study table.

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	83	INF	
Item	I	40	40	1 2 3 4 5 6 7 9 10 11 13 15 16 17 18 19 20 22 23 24 26 28 29 30 31 32 33 34 36 37 39 40
Occasion	O	3	INF	

Analysis of variance

Source	SS	df	MS	Components: Random	Mixed	Corrected	%	SE
P	82.132	82	1.002	0.025	0.024	0.024	2.7	0.007
I	107.701	7	15.386	-0.019	-0.019	-0.019	0.0	0.041
O	11.631	2	5.815	-0.021	-0.016	-0.016	0.0	0.012
PI	322.383	574	0.562	-0.025	-0.025	-0.025	0.0	0.014
PO	79.203	164	0.483	-0.019	-0.003	-0.003	0.0	0.007
IO	283.197	14	20.228	0.236	0.236	0.236	26.3	0.086
PIO	731.970	1148	0.638	0.638	0.638	0.638	71.0	0.027
Total	1618.215	1991					100%	

G Study Table
(Measurement design P/IO)

Source of variance	Differentiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.024		.....		.....	
	.....	I	.....		(0.000)	0.0
	.....	O	.....		(0.000)	0.0
	.....	PI	(0.000)	0.0	(0.000)	0.0
	.....	PO	(0.000)	0.0	(0.000)	0.0
	.....	IO	.....		0.008	27.0
	.....	PIO	0.022	100.0	0.022	73.0
Sum of variances	0.024		0.022	100%	0.030	100%
Standard deviation	0.155			Relative SE: 0.148	Absolute SE: 0.173	
Coef_G relative			0.53			
Coef_G absolute			0.45			

Grand mean for levels used: 2.318
Variance error of the mean for levels used: 0.009
Standard error of the grand mean: 0.093

Appendix C47

EduG analyses output for the combination of 11 of the most sensitive state items of the STAI (SCI>0.60), for the first sample (*n*=83*)*, including observations and estimation designs, ANOVA and G-study table.

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	83	INF	
Item	I	40	40	1 2 3 4 5 6 7 9 10 11 13 16 17 18 19 20 23 24 26 28 29 30 31 32 34 36 37 39 40
Occasion	O	3	INF	

Analysis of variance

Source	SS	df	MS	Components: Random	Mixed	Corrected	%	SE
P	112.694	82	1.374	0.028	0.028	0.028	3.1	0.007
I	169.217	10	16.922	-0.013	-0.013	-0.013	0.0	0.037
O	14.399	2	7.199	-0.014	-0.008	-0.008	0.0	0.009
PI	473.450	820	0.577	-0.013	-0.013	-0.013	0.0	0.012
PO	80.510	164	0.491	-0.011	0.004	0.004	0.4	0.005
IO	405.007	20	20.250	0.237	0.237	0.237	26.7	0.074
PIO	1011.417	1640	0.617	0.617	0.617	0.617	69.7	0.022
Total	2266.694	2738					100%	

G Study Table
(Measurement design P/IO)

Source of variance	Differentiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.028		.....		.....	
	.....	I	.....		(0.000)	0.0
	.....	O	.....		(0.000)	0.0
	.....	PI	(0.000)	0.0	(0.000)	0.0
	.....	PO	0.001	8.7	0.001	6.5
	.....	IO	.....		0.005	25.9
	.....	PIO	0.014	91.3	0.014	67.6
Sum of variances	0.028		0.015	100%	0.021	100%
Standard deviation	0.166			Relative SE: 0.123	Absolute SE: 0.143	
Coef_G relative			0.64			
Coef_G absolute			0.57			

Grand mean for levels used: 2.237
Variance error of the mean for levels used: 0.006
Standard error of the grand mean: 0.076

Appendix C48

EduG analyses output for the combination of Items, 12, 25, 35 and 38, of the STAI for the first sample (*n*=83), with a high State Component Index from each subscale, including observations and estimation designs, ANOVA and G-study table.

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	83	INF	
Item	I	40	40	1 2 3 4 5 6 7 8 9 10 11 13 14 15 16 17 18 19 20 21 22 23 24 26 27 28 29 30 31 32 33 34 36 37 39 40
Occasion	O	3	INF	

Analysis of variance

Source	SS	df	MS	Components: Random	Mixed	Corrected	%	SE
P	54.456	82	0.664	0.014	0.013	0.013	1.4	0.012
I	17.060	3	5.687	-0.047	-0.047	-0.045	0.0	0.038
O	46.424	2	23.212	0.018	0.023	0.023	2.5	0.056
PI	146.106	246	0.594	-0.030	-0.030	-0.030	0.0	0.023
PO	96.243	164	0.587	-0.025	-0.007	-0.007	0.0	0.019
IO	104.259	6	17.377	0.201	0.201	0.201	21.8	0.105
PIO	337.074	492	0.685	0.685	0.685	0.685	74.3	0.044
Total	801.622	995					100%	

G Study Table
(Measurement design P/IO)

Source of variance	Differentiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.013		.....		.....	
	.....	I	.....		(0.000)	0.0
	.....	O	.....		0.008	10.1
	.....	PI	(0.000)	0.0	(0.000)	0.0
	.....	PO	(0.000)	0.0	(0.000)	0.0
	.....	IO	.....		0.015	20.4
	.....	PIO	0.053	100.0	0.053	69.5
Sum of variances	0.013		0.053	100%	0.076	100%
Standard deviation	0.115			Relative SE: 0.230	Absolute SE: 0.275	
Coef_G relative			0.20			
Coef_G absolute			0.15			

Grand mean for levels used: 2.225
Variance error of the mean for levels used: 0.024
Standard error of the grand mean: 0.155

Appendix C49

EduG analyses output for the combination of the four highest State Component Index items of the STAI, for the first sample (*n*=83*)*, including observations and estimation designs, ANOVA and G-study table.

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	83	INF	
Item	I	40	40	1 2 3 4 5 6 7 9 10 11 13 14 15 16 17 18 19 20 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 39 40
Occasion	O	3	INF	

Analysis of variance

Source	SS	df	MS	Components Random	Mixed	Corrected	%	SE
P	61.803	82	0.754	0.014	0.013	0.013	1.2	0.013
I	65.730	3	21.910	-0.015	-0.015	-0.015	0.0	0.076
O	10.199	2	5.099	-0.063	-0.055	-0.055	0.0	0.041
PI	116.687	246	0.474	-0.063	-0.063	-0.063	0.0	0.020
PO	126.468	164	0.771	0.027	0.044	0.044	4.3	0.024
IO	155.472	6	25.912	0.304	0.304	0.304	29.7	0.156
PIO	325.861	492	0.662	0.662	0.662	0.662	64.7	0.042
Total	862.220	995					100%	

G Study Table
(Measurement design P/IO)

Source of variance	Differentiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.013		.....		.....	
	.....	I	.....		(0.000)	0.0
	.....	O	.....		(0.000)	0.0
	.....	PI	(0.000)	0.0	(0.000)	0.0
	.....	PO	0.015	22.3	0.015	16.4
	.....	IO	.....		0.023	26.3
	.....	PIO	0.051	77.7	0.051	57.3
Sum of variances	0.013		0.066	100%	0.089	100%
Standard deviation	0.112			Relative SE: 0.256	Absolute SE: 0.298	
Coef_G relative			0.16			
Coef_G absolute			0.12			

Grand mean for levels used: 2.431
Variance error of the mean for levels used: 0.024
Standard error of the grand mean: 0.156

Appendix C50

EduG analyses output for the combination of the four highest State Component Index items of the STAI, for the first sample (*n*=83*)*, plus item 25, including observations and estimation designs, ANOVA and G-study table.

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	83	INF	
Item	I	40	40	1 2 3 4 5 6 7 9 10 11 13 14 15 16 17 18 19 20 21 22 23 24 26 27 28 29 30 31 32 33 34 36 37 39 40
Occasion	O	3	INF	

Analysis of variance

Source	SS	df	MS	Components: Random	Mixed	Corrected	%	SE
P	61.144	82	0.746	0.021	0.020	0.020	2.0	0.010
I	52.482	4	13.120	-0.035	-0.035	-0.034	0.0	0.050
O	43.539	2	21.769	0.000	0.006	0.006	0.6	0.044
PI	189.651	328	0.578	-0.039	-0.039	-0.039	0.0	0.020
PO	90.061	164	0.549	-0.029	-0.012	-0.012	0.0	0.014
IO	176.116	8	22.014	0.257	0.257	0.257	26.2	0.119
PIO	456.951	656	0.697	0.697	0.697	0.697	71.1	0.038
Total	1069.944	1244					100%	

G Study Table
(Measurement design P/IO)

Source of variance	Differentiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.020		.....		.....	
	.....	I	.....		(0.000)	0.0
	.....	O	.....		0.002	3.5
	.....	PI	(0.000)	0.0	(0.000)	0.0
	.....	PO	(0.000)	0.0	(0.000)	0.0
	.....	IO	.....		0.015	26.0
	.....	PIO	0.042	100.0	0.042	70.5
Sum of variances	0.020		0.042	100%	0.059	100%
Standard deviation	0.141			Relative SE: 0.204	Absolute SE: 0.243	
Coef_G relative			0.32			
Coef_G absolute			0.25			

Grand mean for levels used: 2.309
Variance error of the mean for levels used: 0.018
Standard error of the grand mean: 0.135

Appendix C51

EduG analyses output for the combination of the four highest State Component Index items of the STAI, for the first sample (*n=83),* plus Item 33, including observations and estimation designs, ANOVA and G-study table.

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	83	INF	
Item	I	40	40	1 2 3 4 5 6 7 9 10 11 13 14 15 16 17 18 19 20 22 23 24 25 26 27 28 29 30 31 32 34 35 36 37 39 40
Occasion	O	3	INF	

Analysis of variance

Source	SS	df	MS	Components: Random	Mixed	Corrected	%	SE
P	70.726	82	0.863	0.024	0.022	0.022	2.2	0.011
I	110.655	4	27.664	0.012	0.012	0.012	1.2	0.078
O	30.373	2	15.186	-0.023	-0.016	-0.016	0.0	0.037
PI	165.611	328	0.505	-0.058	-0.058	-0.058	0.0	0.018
PO	111.361	164	0.679	0.000	0.017	0.017	1.7	0.017
IO	198.173	8	24.772	0.290	0.290	0.290	28.5	0.133
PIO	444.760	656	0.678	0.678	0.678	0.678	66.5	0.037
Total	1131.659	1244					100%	

G Study Table
(Measurement design P/IO)

Source of variance	Differentiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.022		.....		.....	
	.....	I	.....		0.002	3.3
	.....	O	.....		(0.000)	0.0
	.....	PI	(0.000)	0.0	(0.000)	0.0
	.....	PO	0.006	12.4	0.006	8.7
	.....	IO	.....		0.017	26.4
	.....	PIO	0.041	87.6	0.041	61.6
Sum of variances	0.022		0.046	100%	0.66	100%
Standard deviation	0.149			Relative SE: 0.215	Absolute SE: 0.257	
Coef_G relative			0.32			
Coef_G absolute			0.25			

Grand mean for levels used: 2.336
Variance error of the mean for levels used: 0.020
Standard error of the grand mean: 0.143

Appendix C52

EduG analyses output for the combination of the four highest State Component Index items of the STAI, for the first sample (*n=83),* plus Item 27, including observations and estimation designs, ANOVA and G-study table. Output from this analysis is the proposed shorter 5-item state scale.

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	83	INF	
Item	I	40	40	1 2 3 4 5 6 7 9 10 11 13 14 15 16 17 18 19 20 22 23 24 25 26 28 29 30 31 32 33 34 35 36 37 39 40
Occasion	O	3	INF	

Analysis of variance

				Components				
Source	SS	df	MS	Random	Mixed	Corrected	%	SE
P	73.565	82	0.897	0.016	0.015	0.015	1.6	0.011
I	78.583	4	19.646	-0.005	-0/005	-0.005	0.0	0.059
O	3.206	2	1.603	-0.047	-0.041	-0.041	0.0	0.023
PI	156.484	328	0.477	-0.042	-0.042	-0.042	0.0	0.017
PO	128.527	164	0.784	0.036	0.051	0.051	5.6	0.018
IO	168.834	8	21.104	0.247	0.247	0.247	26.9	0.114
PIO	396.100	656	0.604	0.604	0.604	0.604	65.9	0.033
Total	1005.298	1244					100%	

G Study Table
(Measurement design P/IO)

Source of variance	Differentiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.015		.....		.....	
	.....	I	.....		(0.000)	0.0
	.....	O	.....		(0.000)	0.0
	.....	PI	(0.000)	0.0	(0.000)	0.0
	.....	PO	0.017	32.0	0.017	25.1
	.....	IO	.....		0.015	21.8
	.....	PIO	0.036	68.0	0.036	53.2
Sum of variances	0.015		0.053	100%	0.68	100%
Standard deviation	0.122			Relative SE: 0.231		Absolute SE: 0.261
Coef_G relative			0.22			
Coef_G absolute			0.18			

Grand mean for levels used: 2.380
Variance error of the mean for levels used: 0.016
Standard error of the grand mean: 0.125

Appendix C53

EduG analyses output for the combination of 24 items with the most robust characteristics of a trait (SCI<0.50) of the STAI, for the first sample (*n*=83), including observations and estimation designs, ANOVA and G-study table.

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	83	INF	
Item	I	40	40	2 6 8 12 14 15 16 21 22 24 25 27 28 33 35 38
Occasion	O	3	INF	

Analysis of variance

Source	SS	df	MS	Components: Random	Mixed	Corrected	%	SE
P	406.180	82	4.953	0.056	0.061	0.061	7.9	0.011
I	252.056	23	10.959	0.002	0.002	0.002	0.2	0.015
O	1.218	2	0.609	-0.005	-0.002	-0.002	0.0	0.001
PI	1744.583	1886	0.925	0.170	0.170	0.170	22.1	0.011
PO	63.504	164	0.387	-0.001	0.009	0.009	1.2	0.002
IO	458.485	46	9.967	0.115	0.115	0.115	14.9	0.025
PIO	1562.793	3772	0.414	0.414	0.414	0.414	53.7	0.010
Total	4488.819	5975					100%	

G Study Table
(Measurement design P/IO)

Source of variance	Differentiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.061		.....		.....	
	.....	I	.....		0.000	0.4
	.....	O	.....		(0.000)	0.0
	.....	PI	0.003	34.9	0.003	32.2
	.....	PO	0.003	36.9	0.003	34.0
	.....	IO	.....		0.001	7.3
	.....	PIO	0.002	28.3	0.002	26.1
Sum of variances	0.061		0.008	100%	0.009	100%
Standard deviation		0.246		Relative SE: 0.091	Absolute SE: 0.095	
Coef_G relative			0.88			
Coef_G absolute			0.87			

Grand mean for levels used: 2.153
Variance error of the mean for levels used: 0.002
Standard error of the grand mean: 0.039

Appendix C54

EduG analyses output for the combination of 23 items with the most robust characteristics of a trait (SCI<0.49) of the STAI, for the first sample (*n*=83), including observations and estimation designs, ANOVA and G-study table.

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	83	INF	
Item	I	40	40	2 6 8 12 14 15 16 21 22 24 25 27 28 31 33 35 38
Occasion	O	3	INF	

Analysis of variance

Source	SS	df	MS	Components: Random	Mixed	Corrected	%	SE
P	382.052	82	4.659	0.054	0.058	0.058	7.6	0.010
I	243.570	22	11.071	0.003	0.003	0.003	0.4	0.015
O	2.919	2	1.460	-0.004	-0.002	-0.002	0.0	0.001
PI	1687.241	1804	0.935	0.175	0.175	0.175	22.7	0.011
PO	66.472	164	0.405	0.000	0.010	0.010	1.3	0.002
IO	430.511	44	9.784	0.113	0.113	0.113	14.7	0.025
PIO	1480.765	3608	0.410	0.410	0.410	0.410	53.3	0.010
Total	4293.530	5726					100%	

G Study Table
(Measurement design P/IO)

Source of variance	Differentiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.058		.....		.....	
	.....	I	.....		0.000	0.6
	.....	O	.....		(0.000)	0.0
	.....	PI	0.003	35.8	0.003	33.1
	.....	PO	0.003	36.2	0.003	33.4
	.....	IO	.....		0.001	7.1
	.....	PIO	0.003	28.0	0.003	25.9
Sum of variances	0.058		0.009	100%	0.010	100%
Standard deviation	0.242			Relative SE: 0.096	Absolute SE: 0.100	
Coef_G relative			0.86			
Coef_G absolute			0.85			

Grand mean for levels used: 2.160
Variance error of the mean for levels used: 0.002
Standard error of the grand mean: 0.040

Appendix C55

EduG analyses output for the combination of 22 items with the most robust characteristics of a trait (SCI<048) of the STAI, for the first sample (*n*=83), including observations and estimation designs, ANOVA and G-study table.

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	83	INF	
Item	I	40	40	2 6 8 12 14 15 16 20 21 22 24 25 27 28 31 33 35 38
Occasion	O	3	INF	

Analysis of variance

Source	SS	df	MS	Components: Random	Mixed	Corrected	%	SE
P	382.622	82	4.666	0.057	0.061	0.061	8.0	0.011
I	243.154	21	11.579	0.010	0.010	0.010	1.3	0.016
O	0.010	2	0.005	-0.005	-0.002	-0.002	0.0	0.001
PI	1613.619	1722	0.937	0.176	0.176	0.176	23.0	0.011
PO	63.869	164	0.389	-0.001	0.009	0.009	1.2	0.002
IO	360.962	42	8.594	0.099	0.099	0.099	12.9	0.022
PIO	1412.493	3444	0.410	0.410	0.410	0.410	53.6	0.010
Total	4076.728	5477					100%	

G Study Table
(Measurement design P/IO)

Source of variance	Differentiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.061		.....		.....	
	.....	I	.....		0.000	1.9
	.....	O	.....		(0.000)	0.0
	.....	PI	0.004	38.2	0.004	34.9
	.....	PO	0.003	32.1	0.003	29.4
	.....	IO	.....		0.001	6.5
	.....	PIO	0.003	29.7	0.003	27.2
Sum of variances	0.061		0.010	100%	0.011	100%
Standard deviation	0.247			Relative SE: 0.098	Absolute SE: 0.103	
Coef_G relative			0.86			
Coef_G absolute			0.85			

Grand mean for levels used: 2.162
Variance error of the mean for levels used: 0.002
Standard error of the grand mean: 0.042

Appendix C56

EduG analyses output for the combination of 21 items with the most robust characteristics of a trait (SCI<047) of the STAI, for the first sample (*n*=83*)*, including observations and estimation designs, ANOVA and G-study table.

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	83	INF	
Item	I	40	40	2 6 8 9 12 14 15 16 20 21 22 24 25 27 28 31 33 35 38
Occasion	O	3	INF	

Analysis of variance

Source	SS	df	MS	Random	Mixed	Corrected	%	SE
				Components				
P	355.484	82	4.335	0.055	0.059	0.059	7.8	0.011
I	237.824	20	11.891	0.014	0.014	0.013	1.7	0.016
O	2.018	2	1.009	-0.004	-0.002	-0.002	0.0	0.001
PI	1559.953	1640	0.951	0.181	0.181	0.181	23.7	0.012
PO	58.426	164	0.356	-0.003	0.008	0.008	1.0	0.002
IO	319.186	40	7.980	0.091	0.091	0.091	12.0	0.021
PIO	1341.702	3280	0.409	0.409	0.409	0.409	53.8	0.010
Total	3874.596	5228					100%	

G Study Table
(Measurement design P/IO)

Source of variance	Differentiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.059		.....		.....	
	.....	I	.....		0.000	2.8
	.....	O	.....		(0.000)	0.0
	.....	PI	0.004	42.2	0.004	38.3
	.....	PO	0.003	25.9	0.003	23.5
	.....	IO	.....		0.001	6.4
	.....	PIO	0.003	31.9	0.003	28.9
Sum of variances	0.059		0.010	100%	0.011	100%
Standard deviation		0.243		Relative SE: 0.100		Absolute SE: 0.105
Coef_G relative			0.86			
Coef_G absolute			0.84			

Grand mean for levels used: 2.155
Variance error of the mean for levels used: 0.002
Standard error of the grand mean: 0.043

Appendix D1

EduG analyses output for the total STAI for the second sample (*n*=56), including observations and estimation designs, ANOVA and G-study table.

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	83	INF	
Item	I	40	40	
Occasion	O	3	INF	

Analysis of variance

				Components				
Source	SS	df	MS	Random	Mixed	Corrected	%	SE
P	437.285	55	7.951	0.057	0.061	0.061	6.5	0.012
I	312.106	39	8.003	-0.005	-0.005	-0.005	0.0	0.013
O	0.348	2	0.714	-0.004	0.000	0.000	0.0	0.001
PI	2359.019	2145	1.100	0.186	0.186	0.186	19.7	0.012
PO	66.136	110	0.601	0.002	0.015	0.015	1.6	0.002
IO	651.771	78	8.356	0.140	0.140	0.140	14.8	0.024
PIO	2321.079	4290	0.541	0.541	0.541	0.541	57.4	0.012
Total	6147.743	6719					100%	

G Study Table
(Measurement design P/IO)

Source of variance	Differentiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.061		.....		.....	
	.....	I	.....		(0.000)	0.0
	.....	O	.....		0.000	0.0
	.....	PI	(0.000)	0.0	(0.000)	0.0
	.....	PO	0.005	100.0	0.005	100.0
	.....	IO	.....		(0.000)	0.0
	.....	PIO	(0.000)	0.0	(0.000)	0.0
Sum of variances	0.061		0.005	100%	0.005	100%
Standard deviation	0.247			Relative SE: 0.071		Absolute SE: 0.071
Coef_G relative			0.92			
Coef_G absolute			0.92			

Grand mean for levels used: 2.124
Variance error of the mean for levels used: 0.001
Standard error of the grand mean: 0.034

Appendix D2

EduG analyses output for the state subscale of the STAI for the second sample (**n**=56), including observations and estimation designs, ANOVA and G-study table.

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	83	INF	
Item	I	40	40	21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40
Occasion	O	3	INF	

Analysis of variance

				Components				
Source	SS	df	MS	Random	Mixed	Corrected	%	SE
P	510.223	55	9.277	0.138	0.143	0.143	14.5	0.029
I	171.196	19	9.010	0.005	0.005	0.005	0.5	0.019
O	19.588	2	9.794	0.002	0.005	0.005	0.5	0.006
PI	1080.170	1045	1.034	0.169	0.169	0.169	17.1	0.016
PO	51.779	110	0.471	-0.003	0.010	0.010	1.1	0.003
IO	288.234	38	7.585	0.126	0.126	0.126	12.8	0.030
PIO	1102.399	2090	0.527	0.527	0.527	0.527	53.5	0.016
Total	3223.589	3359					100%	

G Study Table
(Measurement design P/IO)

Source of variance	Differentiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.143		.....		.....	
	.....	I	.....		0.000	0.0
	.....	O	.....		0.002	11.3
	.....	PI	0.004	35.2	0.004	28.4
	.....	PO	0.003	28.1	0.003	22.7
	.....	IO	.....		0.001	7.1
	.....	PIO	0.005	36.7	0.005	29.6
Sum of variances	0.143		0.005	100%	0.015	100%
Standard deviation	0.378			Relative SE: 0.111	Absolute SE: 0.123	
Coef_G relative			0.92			
Coef_G absolute			0.90			

Grand mean for levels used: 2.098
Variance error of the mean for levels used: 0.006
Standard error of the grand mean: 0.076

Appendix D3

EduG analyses output for the trait subscale of the STAI for the second sample (n=56), including observations and estimation designs, ANOVA and G-study table.

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	83	INF	
Item	I	40	40	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
Occasion	O	3	INF	

Analysis of variance

Source	SS	df	MS	Components: Random	Mixed	Corrected	%	SE
P	319.016	55	5.800	0.081	0.083	0.083	9.2	0.018
I	136.456	19	7.182	-0.010	-0.010	-0.010	0.0	0.017
O	16.447	2	8.224	0.000	0.003	0.003	0.3	0.005
PI	886.894	1045	0.849	0.098	0.098	0.098	10.9	0.014
PO	73.686	110	0.670	0.006	0.020	0.020	2.2	0.005
IO	327.851	38	8.628	0.144	0.144	0.144	16.0	0.034
PIO	1159.349	2090	0.555	0.555	0.555	0.555	61.5	0.017
Total	2919.700	3359					100%	

G Study Table
(Measurement design P/IO)

Source of variance	Differentiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.083		.....		.....	
	.....	I	.....		(0.000)	0.0
	.....	O	.....		0.001	6.5
	.....	PI	0.003	18.2	0.003	15.6
	.....	PO	0.007	47.4	0.007	40.7
	.....	IO	.....		0.001	7.7
	.....	PIO	0.005	34.4	0.005	29.5
Sum of variances	0.083		0.014	100%	0.016	100%
Standard deviation	0.288			Relative SE: 0.117		Absolute SE: 0.127
Coef_G relative			0.86			
Coef_G absolute			0.84			

Grand mean for levels used: 2.150
Variance error of the mean for levels used: 0.004
Standard error of the grand mean: 0.063

Appendix D4

EduG analyses output for Item 1 of the STAI for the second sample (*n*=56), including observations and estimation designs, and G-study table. Traditional ANOVA was not presented in the second replication sample because it is not contributing additional information relevant to the D-study.

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	83	INF	
Item	I	40	40	2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40
Occasion	O	3	INF	

G Study Table
(Measurement design P/IO)

Source of variance	Differentiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.420		.....		.....	
	.....	I	.....		.....	
	.....	O	.....		0.003	2.5
	.....	PI	.....		.....	
	.....	PO	0.102	100.0	0.102	97.5
	.....	IO	.....		.....	
	.....	PIO	.....	.....	.....	
Sum of variances	0.420		0.102	100%	0.105	100%
Standard deviation	0.648			Relative SE: 0.320		Absolute SE: 0.324
Coef_G relative			0.80			
Coef_G absolute			0.80			

Grand mean for levels used: 1.881
Variance error of the mean for levels used: 0.012
Standard error of the grand mean: 0.110

Appendix D5

EduG analyses output for Item 2 of the STAI for the second sample (*n*=56), including observations and estimation designs, and G-study table. Traditional ANOVA was not presented in the second replication sample because it is not contributing additional information relevant to the D-study.

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	83	INF	
Item	I	40	40	1 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40
Occasion	O	3	INF	

G Study Table
(Measurement design P/IO)

Source of variance	Differentiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.337		.....		.....	
	.....	I	.....		.....	
	.....	O	.....		0.086	38.8
	.....	PI	.....		.....	
	.....	PO	0.136	100.0	0.136	61.2
	.....	IO	.....		.....	
	.....	PIO	.....	.....	.....	
Sum of variances	0.337		0.136	100%	0.222	100%
Standard deviation	0.581			Relative SE: 0.369	Absolute SE: 0.471	
Coef_G relative			0.71			
Coef_G absolute			0.60			

Grand mean for levels used: 1.708
Variance error of the mean for levels used: 0.095
Standard error of the grand mean: 0.308

Appendix D6

EduG analyses output for Item 3 of the STAI for the second sample (*n*=56), including observations and estimation designs, and G-study table. Traditional ANOVA was not presented in the second replication sample because it is not contributing additional information relevant to the D-study.

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	83	INF	
Item	I	40	40	1 2 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40
Occasion	O	3	INF	

G Study Table
(Measurement design P/IO)

Source of variance	Differentiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.327		.....		.....	
	.....	I	.....		.....	
	.....	O	.....		0.040	15.1
	.....	PI	.....		.....	
	.....	PO	0.222	100.0	0.222	84.9
	.....	IO	.....		.....	
	.....	PIO	.....	.....	.....	
Sum of variances	0.327		0.222	100%	0.262	100%
Standard deviation	0.572			Relative SE: 0.472		Absolute SE: 0.512
Coef_G relative			0.60			
Coef_G absolute			0.56			

Grand mean for levels used: 2.161
Variance error of the mean for levels used: 0.049
Standard error of the grand mean: 0.222

Appendix D7

EduG analyses output for Item 4 of the STAI for the second sample (*n*=56), including observations and estimation designs, and G-study table. Traditional ANOVA was not presented in the second replication sample because it is not contributing additional information relevant to the D-study.

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	83	INF	
Item	I	40	40	1 2 3 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40
Occasion	O	3	INF	

G Study Table
(Measurement design P/IO)

Source of variance	Differentiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.450		.....		.....	
	.....	I	.....		.....	
	.....	O	.....		0.023	16.1
	.....	PI	.....		.....	
	.....	PO	0.120	100.0	0.120	83.9
	.....	IO	.....		.....	
	.....	PIO	.....	.....	.....	
Sum of variances	0.450		0.120	100%	0.143	100%
Standard deviation	0.671			Relative SE: 0.346		Absolute SE: 0.378
Coef_G relative			0.79			
Coef_G absolute			0.76			

Grand mean for levels used: 2.107
Variance error of the mean for levels used: 0.033
Standard error of the grand mean: 0.182

Appendix D8

EduG analyses output for Item 5 of the STAI for the second sample (*n*=56), including observations and estimation designs, and G-study table. Traditional ANOVA was not presented in the second replication sample because it is not contributing additional information relevant to the D-study.

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	83	INF	
Item	I	40	40	1 2 3 4 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40
Occasion	O	3	INF	

G Study Table
(Measurement design P/IO)

Source of variance	Differentiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.377		.....		.....	
	.....	I	.....		.....	
	.....	O	.....		0.044	24.4
	.....	PI	.....		.....	
	.....	PO	0.135	100.0	0.135	75.6
	.....	IO	.....		.....	
	.....	PIO	.....	.....	.....	
Sum of variances	0.377		0.135	100%	0.179	100%
Standard deviation	0.614			Relative SE: 0.367		Absolute SE: 0.423
Coef_G relative			0.74			
Coef_G absolute			0.68			

Grand mean for levels used: 1.762
Variance error of the mean for levels used: 0.053
Standard error of the grand mean: 0.230

Appendix D9

EduG analyses output for Item 6 of the STAI for the second sample (*n*=56), including observations and estimation designs, and G-study table. Traditional ANOVA was not presented in the second replication sample because it is not contributing additional information relevant to the D-study.

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	83	INF	
Item	I	40	40	1 2 3 4 5 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40
Occasion	O	3	INF	

G Study Table
(Measurement design P/IO)

Source of variance	Differentiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.146		.....		.....	
	.....	I	.....		.....	
	.....	O	.....		0.041	17.5
	.....	PI	.....		.....	
	.....	PO	0.193	100.0	0.193	82.5
	.....	IO	.....		.....	
	.....	PIO	.....	.....	.....	
Sum of variances	0.146		0.193	100%	0.234	100%
Standard deviation	0.382			Relative SE: 0.440	Absolute SE: 0.484	
Coef_G relative			0.43			
Coef_G absolute			0.38			

Grand mean for levels used: 1.821
Variance error of the mean for levels used: 0.047
Standard error of the grand mean: 0.217

Appendix D10

EduG analyses output for Item 7 of the STAI for the second sample (*n*=56), including observations and estimation designs, and G-study table. Traditional ANOVA was not presented in the second replication sample because it is not contributing additional information relevant to the D-study.

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	83	INF	
Item	I	40	40	1 2 3 4 5 6 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40
Occasion	O	3	INF	

G Study Table
(Measurement design P/IO)

Source of variance	Differentiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.519		.....		.....	
	.....	I	.....		.....	
	.....	O	.....		0.021	17.6
	.....	PI	.....		.....	
	.....	PO	0.100	100.0	0.100	82.4
	.....	IO	.....		.....	
	.....	PIO	.....	.....	.....	
Sum of variances	0.519		0.100	100%	0.121	100%
Standard deviation	0.720			Relative SE: 0.316	Absolute SE: 0.348	
Coef_G relative			0.84			
Coef_G absolute			0.81			

Grand mean for levels used: 2.292
Variance error of the mean for levels used: 0.032
Standard error of the grand mean: 0.180

Appendix D11

EduG analyses output for Item 8 of the STAI for the second sample (*n*=56), including observations and estimation designs, and G-study table. Traditional ANOVA was not presented in the second replication sample because it is not contributing additional information relevant to the D-study.

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	83	INF	
Item	I	40	40	1 2 3 4 5 6 7 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40
Occasion	O	3	INF	

G Study Table
(Measurement design P/IO)

Source of variance	Differentiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	(0.000)		.....		.....	
	.....	I	.....		.....	
	.....	O	.....		0.096	27.1
	.....	PI	.....		.....	
	.....	PO	0.259	100.0	0.259	72.9
	.....	IO	.....		.....	
	.....	PIO	.....	.....	.....	
Sum of variances	0.000		0.259	100%	0.355	100%
Standard deviation	0.000			Relative SE: 0.509		Absolute SE: 0.596
Coef_G relative			0.00			
Coef_G absolute			0.00			

Grand mean for levels used: 2.661
Variance error of the mean for levels used: 0.101
Standard error of the grand mean: 0.318

Appendix D12

EduG analyses output for Item 9 of the STAI for the second sample (*n*=56), including observations and estimation designs, and G-study table. Traditional ANOVA was not presented in the second replication sample because it is not contributing additional information relevant to the D-study.

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	83	INF	
Item	I	40	40	1 2 3 4 5 6 7 8 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40
Occasion	O	3	INF	

G Study Table
(Measurement design P/IO)

Source of variance	Differentiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.265		.....		.....	
	.....	I	.....		.....	
	.....	O	.....		0.048	21.8
	.....	PI	.....		.....	
	.....	PO	0.174	100.0	0.174	78.2
	.....	IO	.....		.....	
	.....	PIO	.....	.....	.....	
Sum of variances	0.265		0.174	100%	0.222	100%
Standard deviation	0.514			Relative SE: 0.417	Absolute SE: 0.471	
Coef_G relative			0.60			
Coef_G absolute			0.54			

Grand mean for levels used: 2.244
Variance error of the mean for levels used: 0.056
Standard error of the grand mean: 0.237

Appendix D13

EduG analyses output for Item 10 of the STAI for the second sample (*n*=56), including observations and estimation designs, and G-study table. Traditional ANOVA was not presented in the second replication sample because it is not contributing additional information relevant to the D-study.

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	83	INF	
Item	I	40	40	1 2 3 4 5 6 7 8 9 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40
Occasion	O	3	INF	

G Study Table
(Measurement design P/IO)

Source of variance	Differentiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.396		.....		.....	
	.....	I	.....		.....	
	.....	O	.....		0.018	13.6
	.....	PI	.....		.....	
	.....	PO	0.117	100.0	0.117	86.4
	.....	IO	.....		.....	
	.....	PIO	.....	.....	.....	
Sum of variances	0.396		0.117	100%	0.135	100%
Standard deviation	0.629			Relative SE: 0.341		Absolute SE: 0.367
Coef_G relative			0.77			
Coef_G absolute			0.75			

Grand mean for levels used: 2.137
Variance error of the mean for levels used: 0.028
Standard error of the grand mean: 0.166

Appendix D14

EduG analyses output for Item 11 of the STAI for the second sample (*n*=56), including observations and estimation designs, and G-study table. Traditional ANOVA was not presented in the second replication sample because it is not contributing additional information relevant to the D-study.

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	83	INF	
Item	I	40	40	1 2 3 4 5 6 7 8 9 10 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40
Occasion	O	3	INF	

G Study Table
(Measurement design P/IO)

Source of variance	Differentiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.275		.....		.....	
	.....	I	.....		.....	
	.....	O	.....		0.000	0.2
	.....	PI	.....		.....	
	.....	PO	0.194	100.0	0.194	99.8
	.....	IO	.....		.....	
	.....	PIO	.....	.....	.....	
Sum of variances	0.275		0.194	100%	0.194	100%
Standard deviation	0.524			Relative SE: 0.441	Absolute SE: 0.441	
Coef_G relative			0.59			
Coef_G absolute			0.59			

Grand mean for levels used: 2.292
Variance error of the mean for levels used: 0.009
Standard error of the grand mean: 0.094

Appendix D15

EduG analyses output for Item 12 of the STAI for the second sample (*n*=56), including observations and estimation designs, and G-study table. Traditional ANOVA was not presented in the second replication sample because it is not contributing additional information relevant to the D-study.

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	83	INF	
Item	I	40	40	1 2 3 4 5 6 7 8 9 10 11 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40
Occasion	O	3	INF	

G Study Table
(Measurement design P/IO)

Source of variance	Differentiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	(0.000)		.....		.....	
	.....	I	.....		.....	
	.....	O	.....		0.000	12.7
	.....	PI	.....		.....	
	.....	PO	0.274	100.0	0.274	87.3
	.....	IO	.....		.....	
	.....	PIO	.....	.....	.....	
Sum of variances	0.000		0.274	100%	0.313	100%
Standard deviation	0.000			Relative SE: 0.523		Absolute SE: 0.560
Coef_G relative			0.00			
Coef_G absolute			0.00			

Grand mean for levels used: 2.149
Variance error of the mean for levels used: 0.045
Standard error of the grand mean: 0.211

Appendix D16

EduG analyses output for Item 13 of the STAI for the second sample (*n*=56), including observations and estimation designs, and G-study table. Traditional ANOVA was not presented in the second replication sample because it is not contributing additional information relevant to the D-study.

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	83	INF	
Item	I	40	40	1 2 3 4 5 6 7 8 9 10 11 12 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40
Occasion	O	3	INF	

G Study Table
(Measurement design P/IO)

Source of variance	Differentiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.290		.....		.....	
	.....	I	.....		.....	
	.....	O	.....		0.000	0.1
	.....	PI	.....		.....	
	.....	PO	0.172	100.0	0.172	99.9
	.....	IO	.....		.....	
	.....	PIO	.....	.....	.....	
Sum of variances	0.290		0.172	100%	0.173	100%
Standard deviation	0.538			Relative SE: 0.415		Absolute SE: 0.415
Coef_G relative			0.63			
Coef_G absolute			0.63			

Grand mean for levels used: 2.286
Variance error of the mean for levels used: 0.008
Standard error of the grand mean: 0.092

Appendix D17

EduG analyses output for Item 14 of the STAI for the second sample (*n*=56), including observations and estimation designs, and G-study table. Traditional ANOVA was not presented in the second replication sample because it is not contributing additional information relevant to the D-study.

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	83	INF	
Item	I	40	40	1 2 3 4 5 6 7 8 9 10 11 12 13 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40
Occasion	O	3	INF	

G Study Table
(Measurement design P/IO)

Source of variance	Differentiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.145		.....		.....	
	.....	I	.....		.....	
	.....	O	.....		0.002	0.6
	.....	PI	.....		.....	
	.....	PO	0.250	100.0	0.250	99.4
	.....	IO	.....		.....	
	.....	PIO	.....	.....	.....	
Sum of variances	0.145		0.250	100%	0.252	100%
Standard deviation	0.380			Relative SE: 0.500	Absolute SE: 0.502	
Coef_G relative			0.37			
Coef_G absolute			0.36			

Grand mean for levels used: 2.137
Variance error of the mean for levels used: 0.009
Standard error of the grand mean: 0.093

Appendix D18

EduG analyses output for Item 15 of the STAI for the second sample (*n*=56), including observations and estimation designs, and G-study table. Traditional ANOVA was not presented in the second replication sample because it is not contributing additional information relevant to the D-study.

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	83	INF	
Item	I	40	40	1 2 3 4 5 6 7 8 9 10 11 12 13 14 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40
Occasion	O	3	INF	

G Study Table
(Measurement design P/IO)

Source of variance	Differentiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.319		.....		.....	
	.....	I	.....		.....	
	.....	O	.....		0.042	16.2
	.....	PI	.....		.....	
	.....	PO	0.214	100.0	0.214	83.8
	.....	IO	.....		.....	
	.....	PIO	.....	.....	.....	
Sum of variances	0.319		0.214	100%	0.256	100%
Standard deviation	0.565			Relative SE: 0.463	Absolute SE: 0.506	
Coef_G relative			0.60			
Coef_G absolute			0.55			

Grand mean for levels used: 2.000
Variance error of the mean for levels used: 0.051
Standard error of the grand mean: 0.226

Appendix D19

EduG analyses output for Item 16 of the STAI for the second sample (*n*=56), including observations and estimation designs, and G-study table. Traditional ANOVA was not presented in the second replication sample because it is not contributing additional information relevant to the D-study.

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	83	INF	
Item	I	40	40	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40
Occasion	O	3	INF	

G Study Table
(Measurement design P/IO)

Source of variance	Differentiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.355		.....		.....	
	.....	I	.....		.....	
	.....	O	.....		0.138	40.5
	.....	PI	.....		.....	
	.....	PO	0.203	100.0	0.203	59.5
	.....	IO	.....		.....	
	.....	PIO	.....	.....	.....	
Sum of variances	0.355		0.203	100%	0.341	100%
Standard deviation	0.596			Relative SE: 0.451	Absolute SE: 0.584	
Coef_G relative			0.64			
Coef_G absolute			0.51			

Grand mean for levels used: 2.042
Variance error of the mean for levels used: 0.148
Standard error of the grand mean: 0.385

Appendix D20

EduG analyses output for Item 17 of the STAI for the second sample (*n*=56), including observations and estimation designs, and G-study table. Traditional ANOVA was not presented in the second replication sample because it is not contributing additional information relevant to the D-study.

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	83	INF	
Item	I	40	40	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40
Occasion	O	3	INF	

G Study Table
(Measurement design P/IO)

Source of variance	Differentiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.393		.....		.....	
	.....	I	.....		.....	
	.....	O	.....		0.014	8.5
	.....	PI	.....		.....	
	.....	PO	0.156	100.0	0.156	91.5
	.....	IO	.....		.....	
	.....	PIO	.....	.....	.....	
Sum of variances	0.393		0.156	100%	0.171	100%
Standard deviation	0.627			Relative SE: 0.395		Absolute SE: 0.413
Coef_G relative			0.72			
Coef_G absolute			0.70			

Grand mean for levels used: 2.173
Variance error of the mean for levels used: 0.024
Standard error of the grand mean: 0.156

Appendix D21

EduG analyses output for Item 18 of the STAI for the second sample (*n*=56), including observations and estimation designs, and G-study table. Traditional ANOVA was not presented in the second replication sample because it is not contributing additional information relevant to the D-study.

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	83	INF	
Item	I	40	40	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40
Occasion	O	3	INF	

G Study Table
(Measurement design P/IO)

Source of variance	Differentiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.340		.....		.....	
	.....	I	.....		.....	
	.....	O	.....		0.005	3.1
	.....	PI	.....		.....	
	.....	PO	0.142	100.0	0.142	96.9
	.....	IO	.....		.....	
	.....	PIO	.....	.....	.....	
Sum of variances	0.340		0.142	100%	0.147	100%
Standard deviation	0.583			Relative SE: 0.377	Absolute SE: 0.383	
Coef_G relative			0.71			
Coef_G absolute			0.70			

Grand mean for levels used: 1.732
Variance error of the mean for levels used: 0.013
Standard error of the grand mean: 0.115

Appendix D22

EduG analyses output for Item 19 of the STAI for the second sample (*n*=56), including observations and estimation designs, and G-study table. Traditional ANOVA was not presented in the second replication sample because it is not contributing additional information relevant to the D-study.

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	83	INF	
Item	I	40	40	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40
Occasion	O	3	INF	

G Study Table
(Measurement design P/IO)

Source of variance	Differentiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.681		.....		.....	
	.....	I	.....		.....	
	.....	O	.....		0.011	7.7
	.....	PI	.....		.....	
	.....	PO	0.126	100.0	0.126	92.3
	.....	IO	.....		.....	
	.....	PIO	.....	.....	.....	
Sum of variances	0.681		0.126	100%	0.137	100%
Standard deviation	0.825			Relative SE: 0.355		Absolute SE: 0.370
Coef_G relative			0.84			
Coef_G absolute			0.83			

Grand mean for levels used: 2.149
Variance error of the mean for levels used: 0.025
Standard error of the grand mean: 0.158

Appendix D23

EduG analyses output for Item 20 of the STAI for the second sample (*n*=56), including observations and estimation designs, and G-study table. Traditional ANOVA was not presented in the second replication sample because it is not contributing additional information relevant to the D-study.

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	83	INF	
Item	I	40	40	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40
Occasion	O	3	INF	

G Study Table
(Measurement design P/IO)

Source of variance	Differentiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.152		.....		.....	
	.....	I	.....		.....	
	.....	O	.....		0.182	46.8
	.....	PI	.....		.....	
	.....	PO	0.207	100.0	0.207	53.2
	.....	IO	.....		.....	
	.....	PIO	.....	.....	.....	
Sum of variances	0.152		0.207	100%	0.137	100%
Standard deviation	0.390			Relative SE: 0.455	Absolute SE: 0.624	
Coef_G relative			0.42			
Coef_G absolute			0.28			

Grand mean for levels used: 2.232
Variance error of the mean for levels used: 0.188
Standard error of the grand mean: 0.434

Appendix D24

EduG analyses output for Item 21 of the STAI for the second sample (*n*=56), including observations and estimation designs, and G-study table. Traditional ANOVA was not presented in the second replication sample because it is not contributing additional information relevant to the D-study.

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	83	INF	
Item	I	40	40	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40
Occasion	O	3	INF	

G Study Table
(Measurement design P/IO)

Source of variance	Differentiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	(0.000)		.....		.....	
	.....	I	.....		.....	
	.....	O	.....		0.135	39.1
	.....	PI	.....		.....	
	.....	PO	0.210	100.0	0.210	60.9
	.....	IO	.....		.....	
	.....	PIO	.....	.....	.....	
Sum of variances	0.000		0.210	100%	0.345	100%
Standard deviation	0.000			Relative SE: 0.459	Absolute SE: 0.588	
Coef_G relative			0.00			
Coef_G absolute			0.00			

Grand mean for levels used: 2.631
Variance error of the mean for levels used: 0.139
Standard error of the grand mean: 0.372

Appendix D25

EduG analyses output for Item 22 of the STAI for the second sample (*n*=56), including observations and estimation designs, and G-study table. Traditional ANOVA was not presented in the second replication sample because it is not contributing additional information relevant to the D-study.

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	83	INF	
Item	I	40	40	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40
Occasion	O	3	INF	

G Study Table
(Measurement design P/IO)

Source of variance	Differentiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.266		.....		.....	
	.....	I	.....		.....	
	.....	O	.....		0.039	19.7
	.....	PI	.....		.....	
	.....	PO	0.158	100.0	0.158	80.3
	.....	IO	.....		.....	
	.....	PIO	.....	.....	.....	
Sum of variances	0.266		0.158	100%	0.196	100%
Standard deviation	0.516			Relative SE: 0.397	Absolute SE: 0.443	
Coef_G relative			0.63			
Coef_G absolute			0.58			

Grand mean for levels used: 2.155
Variance error of the mean for levels used: 0.046
Standard error of the grand mean: 0.215

Appendix D26

EduG analyses output for Item 23 of the STAI for the second sample (*n*=56), including observations and estimation designs, and G-study table. Traditional ANOVA was not presented in the second replication sample because it is not contributing additional information relevant to the D-study.

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	83	INF	
Item	I	40	40	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40
Occasion	O	3	INF	

G Study Table
(Measurement design P/IO)

Source of variance	Differentiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.349		.....		.....	
	.....	I	.....		.....	
	.....	O	.....		0.013	7.3
	.....	PI	.....		.....	
	.....	PO	0.162	100.0	0.162	92.7
	.....	IO	.....		.....	
	.....	PIO	.....	.....	.....	
Sum of variances	0.349		0.162	100%	0.175	100%
Standard deviation	0.591			Relative SE: 0.402		Absolute SE: 0.418
Coef_G relative			0.68			
Coef_G absolute			0.67			

Grand mean for levels used: 2.244
Variance error of the mean for levels used: 0.022
Standard error of the grand mean: 0.148

Appendix D27

EduG analyses output for Item 24 of the STAI for the second sample (*n*=56), including observations and estimation designs, and G-study table. Traditional ANOVA was not presented in the second replication sample because it is not contributing additional information relevant to the D-study.

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	83	INF	
Item	I	40	40	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40
Occasion	O	3	INF	

G Study Table
(Measurement design P/IO)

Source of variance	Differentiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.184		.....		.....	
	.....	I	.....		.....	
	.....	O	.....		0.004	2.2
	.....	PI	.....		.....	
	.....	PO	0.188	100.0	0.188	97.8
	.....	IO	.....		.....	
	.....	PIO	.....	.....	.....	
Sum of variances	0.184		0.188	100%	0.192	100%
Standard deviation	0.428			Relative SE: 0.434		Absolute SE: 0.439
Coef_G relative			0.49			
Coef_G absolute			0.49			

Grand mean for levels used: 2.173
Variance error of the mean for levels used: 0.011
Standard error of the grand mean: 0.105

Appendix D28

EduG analyses output for Item 25 of the STAI for the second sample (*n*=56), including observations and estimation designs, and G-study table. Traditional ANOVA was not presented in the second replication sample because it is not contributing additional information relevant to the D-study.

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	83	INF	
Item	I	40	40	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40
Occasion	O	3	INF	

G Study Table
(Measurement design P/IO)

Source of variance	Differentiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	(0.000)		.....		.....	
	.....	I	.....		.....	
	.....	O	.....		0.091	24.4
	.....	PI	.....		.....	
	.....	PO	0.280	100.0	0.280	75.6
	.....	IO	.....		.....	
	.....	PIO	.....	.....	.....	
Sum of variances	0.000		0.280	100%	0.371	100%
Standard deviation	0.000			Relative SE: 0.529	Absolute SE: 0.609	
Coef_G relative			0.00			
Coef_G absolute			0.00			

Grand mean for levels used: 2.208
Variance error of the mean for levels used: 0.096
Standard error of the grand mean: 0.309

Appendix D29

EduG analyses output for Item 26 of the STAI for the second sample (*n*=56), including observations and estimation designs, and G-study table. Traditional ANOVA was not presented in the second replication sample because it is not contributing additional information relevant to the D-study.

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	83	INF	
Item	I	40	40	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 27 28 29 30 31 32 33 34 35 36 37 38 39 40
Occasion	O	3	INF	

G Study Table
(Measurement design P/IO)

Source of variance	Differentiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.273		.....		.....	
	.....	I	.....		.....	
	.....	O	.....		0.004	2.2
	.....	PI	.....		.....	
	.....	PO	0.192	100.0	0.192	97.8
	.....	IO	.....		.....	
	.....	PIO	.....	.....	.....	
Sum of variances	0.273		0.192	100%	0.196	100%
Standard deviation	0.522			Relative SE: 0.438	Absolute SE: 0.443	
Coef_G relative			0.59			
Coef_G absolute			0.58			

Grand mean for levels used: 2.292
Variance error of the mean for levels used: 0.013
Standard error of the grand mean: 0.112

Appendix D30

EduG analyses output for Item 27 of the STAI for the second sample (*n*=56), including observations and estimation designs, and G-study table. Traditional ANOVA was not presented in the second replication sample because it is not contributing additional information relevant to the D-study.

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	83	INF	
Item	I	40	40	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 28 29 30 31 32 33 34 35 36 37 38 39 40
Occasion	O	3	INF	

G Study Table
(Measurement design P/IO)

Source of variance	Differentiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.077		.....		.....	
	.....	I	.....		.....	
	.....	O	.....		0.020	9.0
	.....	PI	.....		.....	
	.....	PO	0.199	100.0	0.199	91.0
	.....	IO	.....		.....	
	.....	PIO	.....	.....	.....	
Sum of variances	0.077		0.199	100%	0.218	100%
Standard deviation	0.278			Relative SE: 0.446	Absolute SE: 0.467	
Coef_G relative			0.28			
Coef_G absolute			0.26			

Grand mean for levels used: 2.083
Variance error of the mean for levels used: 0.024
Standard error of the grand mean: 0.156

Appendix D31

EduG analyses output for Item 28 of the STAI for the second sample (*n*=56), including observations and estimation designs, and G-study table. Traditional ANOVA was not presented in the second replication sample because it is not contributing additional information relevant to the D-study.

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	83	INF	
Item	I	40	40	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 29 30 31 32 33 34 35 36 37 38 39 40
Occasion	O	3	INF	

G Study Table
(Measurement design P/IO)

Source of variance	Differentiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.189		.....		.....	
	.....	I	.....		.....	
	.....	O	.....		0.008	4.8
	.....	PI	.....		.....	
	.....	PO	0.161	100.0	0.161	95.2
	.....	IO	.....		.....	
	.....	PIO	.....	.....	.....	
Sum of variances	0.189		0.161	100%	0.169	100%
Standard deviation	0.434			Relative SE: 0.401	Absolute SE: 0.411	
Coef_G relative			0.54			
Coef_G absolute			0.53			

Grand mean for levels used: 1.786
Variance error of the mean for levels used: 0.014
Standard error of the grand mean: 0.120

Appendix D32

EduG analyses output for Item 29 of the STAI for the second sample (n=56), including observations and estimation designs, and G-study table. Traditional ANOVA was not presented in the second replication sample because it is not contributing additional information relevant to the D-study.

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	83	INF	
Item	I	40	40	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 30 31 32 33 34 35 36 37 38 39 40
Occasion	O	3	INF	

G Study Table
(Measurement design P/IO)

Source of variance	Differentiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.292		.....		.....	
	.....	I	.....		.....	
	.....	O	.....		0.080	36.8
	.....	PI	.....		.....	
	.....	PO	0.137	100.0	0.137	63.2
	.....	IO	.....		.....	
	.....	PIO	.....	.....	.....	
Sum of variances	0.292		0.137	100%	0.216	100%
Standard deviation	0.540			Relative SE: 0.370	Absolute SE: 0.465	
Coef_G relative			0.68			
Coef_G absolute			0.57			

Grand mean for levels used: 1.833
Variance error of the mean for levels used: 0.087
Standard error of the grand mean: 0.295

Appendix D33

EduG analyses output for Item 30 of the STAI for the second sample (*n*=56), including observations and estimation designs, and G-study table. Traditional ANOVA was not presented in the second replication sample because it is not contributing additional information relevant to the D-study.

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	83	INF	
Item	I	40	40	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 31 32 33 34 35 36 37 38 39 40
Occasion	O	3	INF	

G Study Table
(Measurement design P/IO)

Source of variance	Differentiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.403		.....		.....	
	.....	I	.....		.....	
	.....	O	.....		0.052	31.1
	.....	PI	.....		.....	
	.....	PO	0.116	100.0	0.116	68.9
	.....	IO	.....		.....	
	.....	PIO	.....	.....	.....	
Sum of variances	0.403		0.116	100%	0.169	100%
Standard deviation	0.635			Relative SE: 0.341	Absolute SE: 0.411	
Coef_G relative			0.78			
Coef_G absolute			0.71			

Grand mean for levels used: 2.125
Variance error of the mean for levels used: 0.062
Standard error of the grand mean: 0.248

Appendix D34

EduG analyses output for Item 31 of the STAI for the second sample (*n*=56), including observations and estimation designs, and G-study table. Traditional ANOVA was not presented in the second replication sample because it is not contributing additional information relevant to the D-study.

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	83	INF	
Item	I	40	40	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 32 33 34 35 36 37 38 39 40
Occasion	O	3	INF	

G Study Table
(Measurement design P/IO)

Source of variance	Differentiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.197		.....		.....	
	.....	I	.....		.....	
	.....	O	.....		0.054	22.8
	.....	PI	.....		.....	
	.....	PO	0.182	100.0	0.182	77.2
	.....	IO	.....		.....	
	.....	PIO	.....	.....	.....	
Sum of variances	0.197		0.182	100%	0.236	100%
Standard deviation	0.443			Relative SE: 0.427	Absolute SE: 0.486	
Coef_G relative			0.52			
Coef_G absolute			0.45			

Grand mean for levels used: 1.863
Variance error of the mean for levels used: 0.061
Standard error of the grand mean: 0.246

Appendix D35

EduG analyses output for Item 32 of the STAI for the second sample (*n*=56), including observations and estimation designs, and G-study table. Traditional ANOVA was not presented in the second replication sample because it is not contributing additional information relevant to the D-study.

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	83	INF	
Item	I	40	40	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 33 34 35 36 37 38 39 40
Occasion	O	3	INF	

G Study Table
(Measurement design P/IO)

Source of variance	Differentiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.343		.....		.....	
	.....	I	.....		.....	
	.....	O	.....		0.064	33.7
	.....	PI	.....		.....	
	.....	PO	0.126	100.0	0.126	66.3
	.....	IO	.....		.....	
	.....	PIO	.....	.....	.....	
Sum of variances	0.343		0.126	100%	0.190	100%
Standard deviation	0.586			Relative SE: 0.355	Absolute SE: 0.436	
Coef_G relative			0.73			
Coef_G absolute			0.64			

Grand mean for levels used: 1.940
Variance error of the mean for levels used: 0.073
Standard error of the grand mean: 0.269

Appendix D36

EduG analyses output for Item 33 of the STAI for the second sample (n=56), including observations and estimation designs, and G-study table. Traditional ANOVA was not presented in the second replication sample because it is not contributing additional information relevant to the D-study.

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	83	INF	
Item	I	40	40	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 34 35 36 37 38 39 40
Occasion	O	3	INF	

G Study Table
(Measurement design P/IO)

Source of variance	Differentiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.156		.....		.....	
	.....	I	.....		.....	
	.....	O	.....		0.117	35.3
	.....	PI	.....		.....	
	.....	PO	0.214	100.0	0.214	64.7
	.....	IO	.....		.....	
	.....	PIO	.....	.....	.....	
Sum of variances	0.156		0.214	100%	0.331	100%
Standard deviation	0.396			Relative SE: 0.463	Absolute SE: 0.576	
Coef_G relative			0.42			
Coef_G absolute			0.32			

Grand mean for levels used: 1.946
Variance error of the mean for levels used: 0.124
Standard error of the grand mean: 0.352

Appendix D37

EduG analyses output for Item 34 of the STAI for the second sample (*n*=56), including observations and estimation designs, and G-study table. Traditional ANOVA was not presented in the second replication sample because it is not contributing additional information relevant to the D-study.

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	83	INF	
Item	I	40	40	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 35 36 37 38 39 40
Occasion	O	3	INF	

G Study Table
(Measurement design P/IO)

Source of variance	Differentiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.179		.....		.....	
	.....	I	.....		.....	
	.....	O	.....		0.012	6.2
	.....	PI	.....		.....	
	.....	PO	0.177	100.0	0.177	93.8
	.....	IO	.....		.....	
	.....	PIO	.....	.....	.....	
Sum of variances	0.179		0.177	100%	0.188	100%
Standard deviation	0.423			Relative SE: 0.420	Absolute SE: 0.434	
Coef_G relative			0.50			
Coef_G absolute			0.49			

Grand mean for levels used: 2.345
Variance error of the mean for levels used: 0.018
Standard error of the grand mean: 0.135

Appendix D38

EduG analyses output for Item 35 of the STAI for the second sample (*n*=56), including observations and estimation designs, and G-study table. Traditional ANOVA was not presented in the second replication sample because it is not contributing additional information relevant to the D-study.

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	83	INF	
Item	I	40	40	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 36 37 38 39 40
Occasion	O	3	INF	

G Study Table
(Measurement design P/IO)

Source of variance	Differentiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	(0.000)		.....		.....	
	.....	I	.....		.....	
	.....	O	.....		0.186	40.1
	.....	PI	.....		.....	
	.....	PO	0.277	100.0	0.277	59.9
	.....	IO	.....		.....	
	.....	PIO	.....	.....	.....	
Sum of variances	0.000		0.277	100%	0.462	100%
Standard deviation	0.000			Relative SE: 0.526		Absolute SE: 0.680
Coef_G relative			0.00			
Coef_G absolute			0.00			

Grand mean for levels used: 2.381
Variance error of the mean for levels used: 0.191
Standard error of the grand mean: 0.436

Appendix D39

EduG analyses output for Item 36 of the STAI for the second sample (*n*=56), including observations and estimation designs, and G-study table. Traditional ANOVA was not presented in the second replication sample because it is not contributing additional information relevant to the D-study.

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	83	INF	
Item	I	40	40	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 37 38 39 40
Occasion	O	3	INF	

G Study Table
(Measurement design P/IO)

Source of variance	Differentiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.214		.....		.....	
	.....	I	.....		.....	
	.....	O	.....		0.013	7.4
	.....	PI	.....		.....	
	.....	PO	0.156	100.0	0.156	92.6
	.....	IO	.....		.....	
	.....	PIO	.....	.....	.....	
Sum of variances	0.214		0.156	100%	0.169	100%
Standard deviation	0.462			Relative SE: 0.395	Absolute SE: 0.411	
Coef_G relative			0.58			
Coef_G absolute			0.56			

Grand mean for levels used: 2.208
Variance error of the mean for levels used: 0.019
Standard error of the grand mean: 0.138

Appendix D40

EduG analyses output for Item 37 of the STAI for the second sample (*n*=56), including observations and estimation designs, and G-study table. Traditional ANOVA was not presented in the second replication sample because it is not contributing additional information relevant to the D-study.

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	83	INF	
Item	I	40	40	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 38 39 40
Occasion	O	3	INF	

G Study Table
(Measurement design P/IO)

Source of variance	Differentiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.427		.....		.....	
	.....	I	.....		.....	
	.....	O	.....		0.024	14.5
	.....	PI	.....		.....	
	.....	PO	0.144	100.0	0.144	85.5
	.....	IO	.....		.....	
	.....	PIO	.....	.....	.....	
Sum of variances	0.427		0.144	100%	0.169	100%
Standard deviation	0.654			Relative SE: 0.380	Absolute SE: 0.411	
Coef_G relative			0.75			
Coef_G absolute			0.72			

Grand mean for levels used: 2.327
Variance error of the mean for levels used: 0.035
Standard error of the grand mean: 0.186

Appendix D41

EduG analyses output for Item 38 of the STAI for the second sample (*n*=56), including observations and estimation designs, and G-study table. Traditional ANOVA was not presented in the second replication sample because it is not contributing additional information relevant to the D-study.

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	83	INF	
Item	I	40	40	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 39 40
Occasion	O	3	INF	

G Study Table
(Measurement design P/IO)

Source of variance	Differentiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	(0.000)		.....		.....	
	.....	I	.....		.....	
	.....	O	.....		0.003	1.2
	.....	PI	.....		.....	
	.....	PO	0.286	100.0	0.286	98.8
	.....	IO	.....		.....	
	.....	PIO	.....	.....	.....	
Sum of variances	0.000		0.286	100%	0.290	100%
Standard deviation	0.000			Relative SE: 0.535		Absolute SE: 0.538
Coef_G relative			0.00			
Coef_G absolute			0.00			

Grand mean for levels used: 2.196
Variance error of the mean for levels used: 0.009
Standard error of the grand mean: 0.093

Appendix D42

EduG analyses output for Item 39 of the STAI for the second sample (*n*=56), including observations and estimation designs, and G-study table. Traditional ANOVA was not presented in the second replication sample because it is not contributing additional information relevant to the D-study.

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	83	INF	
Item	I	40	40	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 40
Occasion	O	3	INF	

G Study Table
(Measurement design P/IO)

Source of variance	Differentiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.193		.....		.....	
	.....	I	.....		.....	
	.....	O	.....		0.039	18.6
	.....	PI	.....		.....	
	.....	PO	0.173	100.0	0.173	81.4
	.....	IO	.....		.....	
	.....	PIO	.....	.....	.....	
Sum of variances	0.193		0.173	100%	0.212	100%
Standard deviation	0.439			Relative SE: 0.416	Absolute SE: 0.461	
Coef_G relative			0.53			
Coef_G absolute			0.48			

Grand mean for levels used: 2.048
Variance error of the mean for levels used: 0.046
Standard error of the grand mean: 0.214

Appendix D43

EduG analyses output for Item 40 of the STAI for the second sample (*n*=56), including observations and estimation designs, and G-study table. Traditional ANOVA was not presented in the second replication sample because it is not contributing additional information relevant to the D-study.

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	83	INF	
Item	I	40	40	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39
Occasion	O	3	INF	

G Study Table
(Measurement design P/IO)

Source of variance	Differentiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.135		.....		.....	
	.....	I	.....		.....	
	.....	O	.....		0.000	0.2
	.....	PI	.....		.....	
	.....	PO	0.198	100.0	0.198	99.8
	.....	IO	.....		.....	
	.....	PIO	.....	.....	.....	
Sum of variances	0.135		0.198	100%	0.198	100%
Standard deviation	0.368			Relative SE: 0.445		Absolute SE: 0.445
Coef_G relative			0.41			
Coef_G absolute			0.41			

Grand mean for levels used: 2.208
Variance error of the mean for levels used: 0.006
Standard error of the grand mean: 0.079

Appendix D44

EduG analyses output for the combination of the six highest State Component Index items of the STAI, for the second sample (*n*=56), from each subscale, including observations and estimation designs, and G-study table. Traditional ANOVA was not presented in the second replication sample because it is not contributing additional information relevant to the D-study.

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	83	INF	
Item	I	40	40	1 2 3 4 5 6 7 9 10 11 13 14 15 16 17 18 19 20 22 23 24 26 27 28 29 30 31 32 33 34 36 37 39 40
Occasion	O	3	INF	

G Study Table
(Measurement design P/IO)

Source of variance	Differentiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.007		.....		.....	
	.....	I	.....		(0.000)	0.0
	.....	O	.....		(0.000)	0.0
	.....	PI	(0.000)	0.0	(0.000)	0.0
	.....	PO	0.005	12.4	0.005	9.1
	.....	IO	.....		0.016	26.1
	.....	PIO	0.039	87.6	0.039	64.7
Sum of variances	0.007		0.044	100%	0.060	100%
Standard deviation	0.082			Relative SE: 0.210		Absolute SE: 0.244
Coef_G relative			0.13			
Coef_G absolute			0.10			

Grand mean for levels used: 2.371
Variance error of the mean for levels used: 0.016
Standard error of the grand mean: 0.128

Appendix D45

EduG analyses output for the combination of the eight highest State Component Index items of the STAI, for the second sample (n=56), from each subscale, including observations and estimation designs, and G-study table. Traditional ANOVA was not presented in the second replication sample because it is not contributing additional information relevant to the D-study.

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	83	INF	
Item	I	40	40	1 2 3 4 5 6 7 9 10 11 13 15 16 17 18 19 20 22 23 24 26 28 29 30 31 32 33 34 36 37 39 40
Occasion	O	3	INF	

G Study Table
(Measurement design P/IO)

Source of variance	Differentiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.023		.....		.....	
	.....	I	.....		(0.000)	0.0
	.....	O	.....		(0.000)	0.0
	.....	PI	(0.000)	0.0	(0.000)	0.0
	.....	PO	0.002	7.3	0.002	5.7
	.....	IO	.....		0.008	21.8
	.....	PIO	0.027	92.7	0.027	72.6
Sum of variances	0.023		0.029	100%	0.037	100%
Standard deviation	0.152			Relative SE: 0.169		Absolute SE: 0.191
Coef_G relative			0.45			
Coef_G absolute			0.39			

Grand mean for levels used: 2.306
Variance error of the mean for levels used: 0.009
Standard error of the grand mean: 0.094

Appendix D46

EduG analyses output for the combination of the four highest State Component Index items of the STAI, for the second sample (*n*=56), plus item 25, including observations and estimation designs, and G-study table. Traditional ANOVA was not presented in the second replication sample because it is not contributing additional information relevant to the D-study.

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	83	INF	
Item	I	40	40	1 2 3 4 5 6 7 9 10 11 13 14 15 16 17 18 19 20 21 22 23 24 26 27 28 29 30 31 32 33 34 36 37 39 40
Occasion	O	3	INF	

G Study Table
(Measurement design P/IO)

Source of variance	Differentiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.013		.....		.....	
	.....	I	.....		(0.000)	0.0
	.....	O	.....		0.005	6.5
	.....	PI	(0.000)	0.0	(0.000)	0.0
	.....	PO	0.010	16.9	0.010	12.7
	.....	IO	.....		0.014	18.4
	.....	PIO	0.049	83.1	0.049	62.4
Sum of variances	0.013		0.059	100%	0.078	100%
Standard deviation	0.112			Relative SE: 0.242	Absolute SE: 0.280	
Coef_G relative			0.18			
Coef_G absolute			0.14			

Grand mean for levels used: 2.319
Variance error of the mean for levels used: 0.021
Standard error of the grand mean: 0.144

Appendix D47

EduG analyses output for the combination of Items, 12, 25, 35 and 38, of the STAI for the second sample (*n*=56*)*, with a high State Component Index from each subscale, including observations and estimation designs, and G-study table. Traditional ANOVA was not presented in the second replication sample because it is not contributing additional information relevant to the D-study.

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	83	INF	
Item	I	40	40	1 2 3 4 5 6 7 8 9 10 15 16 17 18 19 20 2 26 27 28 29 30 31 3 37 39 40
Occasion	O	3	INF	

G Study Table
(Measurement design P/IO)

Source of variance	Differentiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.005		.....		.....	
	.....	I	.....		(0.000)	0.0
	.....	O	.....		0.001	0.7
	.....	PI	(0.000)	0.0	(0.000)	0.0
	.....	PO	0.011	15.2	0.011	12.1
	.....	IO	.....		0.019	19.9
	.....	PIO	0.063	84.8	0.063	67.3
Sum of variances	0.005		0.075	100%	0.094	100%
Standard deviation	0.070			Relative SE: 0.273		Absolute SE: 0.307
Coef_G relative			0.06			
Coef_G absolute			0.05			

Grand mean for levels used: 2.234
Variance error of the mean for levels used: 0.021
Standard error of the grand mean: 0.144

Appendix D48

EduG analyses output for the combination of the four highest State Component Index items of the STAI, for the second sample (*n*=56*)*, including observations and estimation designs, ANOVA and G-study table.

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	83	INF	
Item	I	40	40	1 2 3 4 5 6 7 9 10 11 13 14 15 16 17 18 19 20 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 39 40
Occasion	O	3	INF	

Analysis of variance

Source	SS	df	MS	Components: Random	Mixed	Corrected	%	SE
P	37.546	55	0.683	0.003	0.001	0.001	0.1	0.016
I	37.885	3	12.628	-0.017	-0.017	-0.017	0.0	0.067
O	4.128	2	2.064	-0.061	-0.054	-0.054	0.0	0.036
PI	101.031	165	0.612	-0.050	-0.050	-0.050	0.0	0.030
PO	88.039	110	0.800	0.009	0.029	0.029	2.7	0.031
IO	94.253	6	15.709	0.267	0.267	0.267	25.2	0.140
PIO	251.580	330	0.762	0.762	0.762	0.762	72.0	0.059
Total	614.463	672					100%	

G Study Table
(Measurement design P/IO)

Source of variance	Differentiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.001		.....		.....	
	.....	I	.....		(0.000)	0.0
	.....	O	.....		(0.000)	0.0
	.....	PI	(0.000)	0.0	(0.000)	0.0
	.....	PO	0.010	14.0	0.010	10.7
	.....	IO	.....		0.021	23.1
	.....	PIO	0.059	86.0	0.059	66.1
Sum of variances	0.001		0.068	100%	0.089	100%
Standard deviation	0.038			Relative SE: 0.261	Absolute SE: 0.298	
Coef_G relative			0.02			
Coef_G absolute			0.02			

Grand mean for levels used: 2.409
Variance error of the mean for levels used: 0.022
Standard error of the grand mean: 0.148

Appendix D49

EduG analyses output for the combination of 11 of the most sensitive state items of the STAI (SCI>0.60), for the second sample (*n*=56), including observations and estimation designs, ANOVA and G-study table.

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	83	INF	
Item	I	40	40	1 2 3 4 5 6 7 9 10 11 13 16 17 18 19 20 23 24 26 28 29 30 31 32 34 36 37 39 40
Occasion	O	3	INF	

Analysis of variance

				Components				
Source	SS	df	MS	Random	Mixed	Corrected	%	SE
P	105.420	55	1.917	0.039	0.039	0.039	3.9	0.011
I	91.791	10	9.179	-0.025	-0.025	-0.024	0.0	0.033
O	9.079	2	4.540	-0.014	-0.008	-0.008	0.0	0.008
PI	428.330	550	0.779	0.017	0.017	0.017	1.7	0.019
PO	64.376	110	0.585	-0.013	0.005	0.005	0.5	0.008
IO	265.040	20	13.252	0.224	0.224	0.224	22.1	0.071
PIO	800.839	1100	0.728	0.728	0.728	0.728	71.9	0.031
Total	1764.874	1847					100%	

G Study Table
(Measurement design P/IO)

Source of variance	Differentiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.039		.....		.....	
	.....	I	.....		(0.000)	0.0
	.....	O	.....		(0.000)	0.0
	.....	PI	0.001	5.9	0.001	4.7
	.....	PO	0.002	9.0	0.002	7.2
	.....	IO	.....		0.005	20.7
	.....	PIO	0.016	85.1	0.016	67.4
Sum of variances	0.039		0.019	100%	0.024	100%
Standard deviation	0.198			Relative SE: 0.139	Absolute SE: 0.156	
Coef_G relative			0.67			
Coef_G absolute			0.62			

Grand mean for levels used: 2.232
Variance error of the mean for levels used: 0.006
Standard error of the grand mean: 0.078

Appendix D50

EduG analyses output for the combination of Items, 8, 12, 14, 27 and 38, of the STAI for the second sample (*n*=56*)*, with a high State Component Index from each subscale, including observations and estimation designs, ANOVA and G-study table.

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	83	INF	
Item	I	40	40	1 2 3 4 5 6 7 9 10 11 13 15 16 17 18 19 20 21 22 23 24 25 26 28 29 30 31 32 33 34 35 36 37 39 40
Occasion	O	3	INF	

Analysis of variance

Source	SS	df	MS	Components: Random	Mixed	Corrected	%	SE
P	65.748	55	1.195	0.030	0.029	0.029	3.1	0.017
I	37.338	4	9.335	0.015	0.015	0.015	1.6	0.037
O	7.217	2	3.608	-0.011	-0.009	-0.009	0.0	0.014
PI	158.395	220	0.720	-0.011	-0.011	-0.011	0.0	0.028
PO	86.517	110	0.787	0.006	0.025	0.025	2.7	0.023
IO	54.355	8	6.794	0.108	0.108	0.108	11.6	0.054
PIO	331.912	440	0.754	0.754	0.754	0.754	81.0	0.051
Total	741.481	839					100%	

G Study Table
(Measurement design P/IO)

Source of variance	Differentiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.029		.....		.....	
	.....	I	.....		0.003	4.3
	.....	O	.....		(0.000)	0.0
	.....	PI	(0.000)	0.0	(0.000)	0.0
	.....	PO	0.008	15.7	0.008	13.4
	.....	IO	.....		0.006	10.3
	.....	PIO	0.045	84.3	0.045	72.0
Sum of variances	0.029		0.054	100%	0.063	100%
Standard deviation		0.171		Relative SE: 0.231		Absolute SE: 0.250
Coef_G relative			0.35			
Coef_G absolute			0.32			

Grand mean for levels used: 2.245
Variance error of the mean for levels used: 0.011
Standard error of the grand mean: 0.103