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Making Better Use of Response Patterns: Evaluating Generalised Anxiety Disorder Through Formal Psychological Assessment

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Abstract

This study provides an extensive understanding of the symptomatology of Generalised Anxiety Disorder (GAD) and lays out a series of items taken from different assessment tools which assess this disorder. This will serve as a first step towards the creation of a formal psychological method of assessment. This study presented insight into the literature which is pertinent to GAD and to Formal Psychological Assessment (FPA). FPA is a growing methodology which allows for the numerical conversion of an individual's responses to the administered assessment method. This allows the clinician to go beyond the score of the assessment result and obtain a clearer picture of the clinical case which would be adaptive to the individual's response patterns. This study created a Boolean matrix for the items assessing GAD and symptoms of this disorder. After a thorough analysis of GAD symptomatology, 19 attributes which represent the disorder were chosen. Furthermore, items evaluating GAD were selected from 7 pre-existing assessment methods and were then linked to the respective attribute/s which they assessed; prototypical items were later selected from the matrix to form an integrated picture of the chosen assessment tools, diminishing the initial number of items needed to form an exhaustive assessment tool from 138 to 42 items. The generated matrix highlighted the relationship between each item and their respective attribute, thus granting the possibility to analyse response patterns in the future, creating the foundation for an adaptive tool for the assessment of GAD.

Keywords: Generalised Anxiety Disorder (GAD), Formal Psychological Assessment (FPA), Anxiety Disorders, Psychopathology, Adaptive assessment

Abstract Italiano

Il presente studio fornisce un'ampia comprensione della sintomatologia del Disturbo d'Ansia Generalizzato (DAG) e presenta una serie di *item* tratti da diversi strumenti di *assesment* atti alla valutazione di tale disturbo. Questo servirà come primo passo verso la creazione di un metodo di valutazione di Formal Psychological Assessment (FPA). Questo presenta una panoramica della letteratura pertinente al DAG e alla FPA. L'FPA è una metodologia relativamente nuova, la quale consente la conversione numerica delle risposte di un individuo al metodo di valutazione amministrato. Ciò permette al professionista di andare oltre rispetto il punteggio ottenuto attraverso la valutazione, ottenendo un quadro più completo del funzionamento del paziente. Inoltre, tale metodo consente un adattamento ai *pattern* di risposta dell'individuo, tale per cui gli *item* proposti non seguiranno l'ordine statico proprio dello strumento di valutazione, saranno proposti in funzione della risposta precedente.

In questo studio si è creata una matrice booleana per gli elementi che valutano il DAG e i relativi sintomi. A seguito di un'analisi approfondita della sintomatologia DAG, sono stati scelti 19 attributi che rappresentano il disturbo. Inoltre, gli elementi che valutavano il DAG sono stati selezionati da sette metodi di valutazione preesistenti che sono stati collegati ai rispettivi attributi che hanno valutato. Dopodiché, gli *item* prototipici sono stati selezionati dalla matrice per formare un quadro integrato degli strumenti di valutazione scelti, diminuendo il numero iniziale di *item* necessari per formare uno strumento di valutazione esaustivo da 138 a 42 *item*.

La matrice generata ha evidenziato la relazione tra ogni *item* e il rispettivo attributo, sostenendo così la possibilità di analizzare in futuro i *pattern* di risposta, creando le basi per uno strumento adattativo per la valutazione del DAG.

Chapter 1: Introduction

1.1   Research aim and overview of this study

The research aim of this study was to apply the Formal Psychological Assessment (FPA; Spoto, 2011; Spoto et al., 2013, 2018; Bottesi et al., 2015; Serra et al., 2015, 2017) methodology to current psychometric tools which can be used for the diagnosis of Generalised Anxiety Disorder (GAD) in order to create a formal representation of the clinical context of GAD. This was done by firstly, reviewing the literature pertaining to GAD in order to create a set of attributes for this theoretical construct. Consistent with FPA methodology, attributes are considered to be the different components which make up the theoretical construct of a given psychological disorder and are usually identified as symptoms or criteria of a given disorder. The clinical context of GAD (represented in the form of a Boolean matrix presenting the relationships between psychometric tool items and attributes) would provide the foundations for future development of an adaptive tool for measuring GAD.

This study starts by presenting a detailed literature review of the aetiology of GAD based on its different models and a summary of the FPA theoretical foundations and its methodology. In Chapter 4, the methodology for carrying out the research aim was explained and then applied to produce the results of this study. A discussion of results, their strengths and limitations, and most importantly, their potential future applications, is presented in Chapter 5 and is followed by a concluding chapter.

1.2   An introduction to Generalised Anxiety Disorder

Generalised Anxiety Disorder is a persistent disorder (6 months or more as per the current Diagnostic and Statistical Manual of Mental Disorders; DSM-5) marked by intense anxiety and worry which the individual finds difficult to control and which in turn present other symptoms which the individual finds debilitating (American Psychiatric Association; APA, 2022). GAD has been estimated to have a lifetime prevalence between 3% to 5% (Kessler et

al., 2005; 2012; Wittchen, 2002). It is more common in adults than it is in adolescents, and it is twice as common in women (APA, 2013). Although the symptoms of anxiety and worry are normal in our day to day lives, these become disproportional to the anticipated event and cause clinically significant distress or impairment in GAD patients. On this note, Borkovec (2005) has argued that GAD could be termed "Severe Normality" as it reflects a state of being which human beings naturally experience. Worry and anxiety are in fact normative to human experience and, as the author suggested, studying extreme manifestations of them could lead us to a deeper understanding of their adaptive nature.

GAD has important implications in other psychological disorders as it holds a degree of risk for the development of various comorbidities. Barlow (2004) identified GAD as "the basic anxiety disorder" due to its characteristics also being central to many other emotional disorders, particularly mood disorders (p. 477). Similarly to Borkovec's (2005) notion, Barlow proposed that studying GAD and its similarity to major depression could lead to a greater understanding of all emotional disorders. This view is strengthened by the findings that the onset of GAD increases the risk of onset of mood disorders, substance abuse disorders, posttraumatic stress disorder, and panic disorder at a later stage in one's life (Ruscio et al., 2007). The idea that GAD can be seen as a risk factor for other disorders was also shared by Tyrer and Baldwin (2006) who asserted that the distinction of GAD as an independent disorder may be inaccurate. Kessler and Walters (2002) have shed light on the fact that 83.3% of individuals with GAD suffer from at least another mood, anxiety, or substance use disorder, making the rate of comorbidity of other disorders with GAD a high one. Despite this, there is substantial neurological evidence for GAD as an independent disorder as it is marked by significant biological markers, with regions related to anxiety neurocircuitry being of particular importance (Maron & Nutt, 2017).

Additionally, GAD has multiple negative implications for clients meeting its criteria. The DSM-5 highlighted a relationship between GAD and diminished work performance, higher medical resource utilisation, and higher rates of cardiovascular disease (APA, 2013). Wittchen (2002) found that GAD patients utilise the healthcare system at higher rates than the general public (with a prevalence of 8% for GAD patients as opposed to and estimated 2%-5% in the general public). Despite having a high personal and societal cost, GAD remains one of the anxiety disorders with the least successful treatment rates (Newman et al., 2013). This study suggests that the application of FPA to GAD measures could provide a useful tool for a deeper understanding of a client's symptoms and thus, potentially increasing efficiency of individualised treatment.

Emmelkamp and Ehring (2014) contended that a significant amount of healthcare providers fails to accurately assess, or even recognise, GAD cases. Gerlach and Gloster (2020) further argued that ambiguous case formulations could be due to the somatic nature of many GAD symptoms and the diagnostic overshadowing which may follow. Tyrer and Baldwin (2006) added that despite anxiety being relatively simple to identify, its interpretation may pose diagnostic difficulties. The high rates of comorbidity with other disorders and the fact that GAD manifestation may be masked by its somatic symptoms calls for an assessment method which is sensitive to the heterogeneity of symptoms which different clients may present. As a result, the diagnosis of GAD is usually done through a less-than-ideal diagnosis which must first exclude all comorbid possibilities since most of its symptoms are not specific to GAD (Tyrer & Baldwin, 2006). Spitzer et al., (2006) suggested that the lack of use of anxiety-measuring psychometric tools in clinical practice is a result of these psychometric tools usually being lengthy and offering little practicality as a diagnostic and severity measure. Spitzer et al., further proposed a brief measure for GAD which this study investigates within its clinical context. The application of FPA to the assessment tools used for GAD could present a more

adaptive and cost-effective way of assessing for this disorder, as well as adding depth to brief

measures of GAD (such as the GAD-7; Spitzer et al., 2006), with its adaptive nature

maintaining efficacy.

Chapter 2: Generalised Anxiety Disorder

2.1   Introduction

This study aims to provide an extensive understanding of Generalised Anxiety Disorder (GAD) and lay out a series of items taken from different assessment tools which assess this disorder. This will serve as a first step towards the creation of a formal psychological method of assessment. This chapter presents an insight into the literature pertinent to GAD: its history, diagnostic taxonomy, and the models making sense of it. The aim of this chapter is to extract the attributes which make up GAD from the scientific literature as to be able to better define what current assessment tools should look for when presented with this disorder or any of its manifestations.

2.2   History of Generalised Anxiety Disorder

2.2.1   Early history

The history of anxiety disorders dates back to Greco-Roman philosophers and physicians who identified and separated normal anxiety from pathological anxiety. Stoic and Epicurean schools (despite holding opposing views) both stressed the importance of being free from what could now be defined as worry in order to live a healthy life. Epicurus (as cited in Crocq, 2022a), the founding father of Epicureanism, held that for one to live a *happy life* he must achieve ataraxia (ἀταραξία), a state in which the mind is free from worry. The path towards this state was to be achieved by freeing the mind from worries about the past or future and concentrating on living in the present moment, an ancient concept which the modern school of Cognitive Behavioural Therapy still embraces (Newman & Borkovec, 2014). Stoic philosophers such as Seneca (ca. 49 AD/2004) embraced this idea and noted how worry could hinder concentration amongst other things. In his essay *On the Shortness of Life* (*De Brevitate Vitae*), Seneca wrote: "Finally, it is generally agreed that no activity can be successfully pursued by an individual who is preoccupied… since the mind when distracted absorbs nothing

deeply, but rejects everything which is, so to speak, crammed into it" (p. 9). In Cicero's time, the Romans had two words which were associated with anxiety: *angor*, which expressed a transient state of fear or panic, and *anxietas*, which expressed a longer-lived state of fearfulness (Stone, 2010). Crocq (2022a) in fact, argued that the first distinction between state and trait anxiety was made by Cicero (ca. 45 BC/2002) when he associated the term *anxietas* to being prone to anxiousness and *angor* to a momentary state of fear, thus preceding Cattell's (1957) work on state and trait anxiety.

2.2.2 Eighteenth and early nineteenth century: A gap in literature

Despite the early advances made during classical antiquity, there is a wide gap in the literature on anxiety disorders between these early times and the 19th century. Stone (2010) pointed out that a possible explanation for this is that due to the universality of 'normal' anxiety as part of human essence, physicians of that time may have opted out from including anxiety disorders into their indexes of mental illnesses. Crocq (2022a) pointed out that patients with anxiety disorders were in fact reported but they were diagnosed with separate mental illnesses. In essence, despite various mentions of anxiety in early texts such as Burton's (1621) encyclopaedic *Anatomy of Melancholy* and Boissier de Sauvages' *Nosologie Méthodique* (1752), anxiety was seen as a symptom of other mental illnesses. It has been argued that the missing link during this period was not knowledge about anxiety per se, but the awareness that anxiety runs across various symptoms and may, as we now know, exacerbate various other mental disorders (Stone, 2010).

One of the first constructs of GAD was listed in the 18th century in the aforementioned *Nosologie Méthodique* as *pantophobia*, a term which originated back in 5th century when the Roman physician Caelius Aurelianus described it as a condition under which an individual would suffer from groundless fears about everything (Oxford English Dictionary, 2022). However, even this term was still not properly developed into what we now know to be GAD.

Crocq (2022a) pointed out that the first form of pantophobia in Boissier de Sauvages' nosology was "little more than a nocturnal terror" (p. 322). Nevertheless, Crocq highlighted that another form of the original pantophobia present in the aforementioned French nosology, *pantophobia phrontis*, was closely related to GAD. In fact, individuals suffering from *pantophobia phrontis* often reported constant and intense worry and complained of bodily pains and tension, symptoms which are present under GAD in the current Diagnostic and Statistical Manual of Mental Disorders (5th. ed. *text rev*.; DSM-5-TR; APA, 2022).

By the mid 19th century, anxiety treatments mainly targeted what were considered as objective measures of discomfort caused by anxiety such as bodily manifestations including palpitations, tremulousness, and shortness of breath (Stone, 2010). Perhaps the most widely used classification of anxiety disorders in this period was *neurasthenia* or an exhaustion of the nervous system, a condition which was initially described by American neurologist George Miller Beard in 1869. In this classical paper Beard compared the nature of neurasthenia to anaemia as he wrote: "Anaemia… is to the vascular system what neurasthenia is to the nervous. The one means want of blood; the other, want of nervous force" (Vol III; no. 13). Beard understood that the diagnosis of neurasthenia was to be obtained through exclusion when the patient manifested no organic diseases (such as anaemia). In such cases, the nervous system was suspected to be at fault for the symptoms associated to neurasthenia, which included: general malaise, poor appetite, weakness in the back and spine, hypochondriases, hysteria, headaches, and symptoms of chronic depression. Neurasthenia quickly gained popularity amongst contemporary physicians, who used it as an umbrella term for close to all anxious manifestations in patients who did not present further complications (Stone, 2010), thus highlighting the limited understanding of anxiety disorders of the time despite the detailed and accurate observations made centuries earlier during classical antiquity, especially regarding treatment.

2.2.3 Bridging the gap: Freud's influence on anxiety disorders

By the end of the 19th century Freud called for the separation of anxiety disorders (described as neurotic disturbances) from neurasthenia in his paper; "On the grounds for detaching a particular syndrome from neurasthenia under the description 'anxiety neurosis'" (1894/1962). He held that despite the strong somatic manifestation which usually overshadowed cognitive symptoms of anxiety in clinical cases, many of the symptoms listed under neurasthenia were more closely linked to each other than to the broader term. In the same paper, Freud painted a clinical picture of *anxiety neurosis,* a disorder which bears more resemblance to GAD than the previously used classifications. Freud's initial understanding of anxiety neurosis shares various symptoms which are still present in the DSM-5-TR (APA, 2022), such as anxious expectation (synonymous to worry), general irritability, disturbance of bodily functions, and sleep disturbance (although it was only mentioned in the form of *pavor nocturnus*). Similarly to current understanding of GAD (APA, 2022), Freud also recognised anxious expectation to be a cardinal symptom of anxiety neurosis. His paper further differentiated between normal and pathological anxious expectation, identifying the latter as a kind of compulsion outside the control of the individual. Furthermore, the described compulsion to worry bore no logical connection to the reality of the anxious stimulus, which was either inexistent or exaggerated by the individual. Freud presented the following clinical example, which is reminiscent of the worry criterion for GAD present in the DSM-5-TR, to describe anxious expectation: "A woman, for instance, who suffers from anxious expectation will think of influenzal pneumonia every time her husband coughs when he has a cold, and, in her mind's eye, will see his funeral go past…" (p. 92). The weakest point of an otherwise sound conceptualisation of anxiety neurosis was perhaps Freud's aetiological understanding of it; initially, it had been argued that anxiety neurosis was a result of built-up sexual energy.

However, Freud's sexual aetiology for anxiety neurosis was refuted later on in the early 20th century whereas the term anxiety neurosis kept being used (Crocq, 2022b).

2.2.4   Generalised Anxiety Disorder in the DSM

According to Crocq (2022a), Freud (1894/1962) coined a great number of terms which were later used for anxiety disorders in the DSM-I and DSM-II (APA, 1952, 1968). Anxiety disorders, which the DSM-I categorised as *psychoneurotic disorders,* were initially divided into separate reactions to unconscious dangers perceived by the personality, which were expressed as an *anxiety reaction* by the conscious part of the personality. An anxiety reaction was considered as anxiety which was diffused to other parts of the self; as long as it was not limited to certain specific objects (as this was considered as a *phobic reaction*). Anxiety reactions were characterised by anxious expectation, Freud's term for modern worry, and were understood to cause various somatic discomforts.

The DSM-II (APA, 1968) changed anxiety reaction to Freud's (1894/1962) anxiety neurosis. According to Crocq (2022a), anxiety neurosis became a nuclear component of the second class of mental illnesses in the DSM-II, neuroses. At the time, anxiety neurosis was associated with panic, exaggerated worry, and somatic symptomatology; thus, grouping panic disorder and GAD under the same diagnostic classification. With the advent of the DSM-III (APA, 1980), a chapter about anxiety disorders was created and subdivided into *anxiety states* (or anxiety neuroses). Under this chapter, GAD was first separated from panic disorder (PD) following research on *Imipramine* (a tricyclic antidepressant) treatment (Klein, 1964). Klein found that whereas Imipramine was effective for the treatment of panic attacks, anticipatory anxiety was not affected, hence pushing for a distinction to be made between the two disorders. Further research on DSM-III GAD found that GAD rarely occurred without the presence of major depressive disorder in the early stages of the disorder, a comorbidity which became less evident as the duration of GAD increased (Breslau & Davis, 1985). Crocq (2022b) highlighted

how this finding warranted the increase of the duration requirement for GAD from 1 month in the DSM-III to 6 months in the DSM-III-R (APA, 1987). Even more importantly, the DSM-III-R changed the main criterion of GAD from anxiety to chronic and pervasive worry, thus recognising the importance of worry within this disorder. Furthermore, the DSM-III-R diagnosis of GAD required a minimum of 6 symptoms from 18 specified symptoms which were divided into 3 symptom categories (i. motor tension, ii. autonomic hyperactivity, iii. vigilance and scanning), whereas the DSM-III did not require a specific number of symptoms for the diagnosis. Eventually, the DSM-IV (APA, 1994) revised this by reducing the number of required symptoms to a minimum of 3 from 6 symptoms and by adding the requirement from uncontrollability of worry, thus emphasising the worry component of GAD. The criterions for GAD present in the DSM-5 and DSM-5-TR (APA, 2013; 2022) remained the same and are listed in Table 1.

Table 2.1. Criteria for Diagnosing GAD: As per DSM-5 and ICD-11

	DSM-5-TR	ICD-11
Main Symptom/s	• Excessive anxiety and worry about various events • Difficulty controlling the worry.	Symptoms of anxiety are shown by at least one of the below: • General apprehensiveness (free-floating anxiety) • or excessive worry about negative events.
Duration	More days than not for a period of at least 6 months	Non-transient symptoms which persist for at least several months, for more days than not.
Number of additional symptoms required for a diagnosis	3 symptoms from a total of 6. Note. Only one item is required for children	Unspecified.
Additional Symptoms: • *Restlessness* • *Mental state*	1. Restlessness/feeling on edge 2. Being easily fatigued	1. Nervousness, restlessness, or feeling on edge 2. Difficulty concentrating

	3. Concentration difficulties/mind going blank 4. Irritability	3. Irritability
• *Motor symptoms*	5. Muscle tension	4. Muscle tension or motor restlessness
• *Sleep disturbance*	6. Difficulty falling or staying asleep, or having restless, unsatisfying sleep	5. Difficulty falling or staying asleep, or having restless, unsatisfying sleep
• *Autonomic Hyperarousal*	Not present as additional symptoms but are considered as associated features since these are relatively less eminent in GAD.	6. Sympathetic autonomic overactivity (i.e., frequent gastrointestinal symptoms such as nausea, heart palpitations, sweating, trembling, shaking, dry mouth).
Impairment to daily living	Symptoms cause clinically significant distress or impairment in important areas of functioning.	Symptoms result in significant distress or significant impairment in important areas of functioning. Note: the ICD-11 asserted that functioning may still be maintained, but only through "significant additional effort."
Exclusion diagnosis	Symptoms are not attributable to the effects of a substance or another medical condition and are not better explained by other mental disorders.	The symptoms are not better explained by another mental disorder, they are not a manifestation of another medical condition and are not due to the effects of a substance or medication.

2.3   Aetiology of Generalised Anxiety Disorder

The current version of the DSM distinguished anxiety disorders from other categories of mental disorders (such as mood disorders, which are frequently present with GAD), by the symptoms of excessive fear and anxiety with which anxiety disorders present themselves (APA, 2022). Whereas anxiety arises from the anticipation of a threat (be it real or perceived), fear is considered as an emotional response to an imminent threat which is associated with an

intense behavioural and/or physiological response, such as the one presented by panic disorders or phobias. Both the DSM-5-TR and the International Statistical Classification of Diseases and Related Health Problems (11th ed.; ICD-11; World Health Organization; WHO, 2019) stressed that anxiety and fear have an evolutionary value, making them adaptive emotions. Anxiety, worry, stress, and fear are normal states which are usually sufficiently self-regulated by the individual and provide a positive disposition to problem-solving. The boundary between normality and pathology is surpassed once the symptoms become excessive and have a negative impact on the psychosocial functioning of the individual in different areas of his life (APA, 2022). Since the symptomatology of GAD is usually associated with an anxious response rather than a fearful one, this chapter shall focus on the component and the functional consequences of anxious expectation; a mental state which despite being associated with numerous other anxiety disorders, remains an indicative feature of GAD.

Early exploration of GAD (Borkovec et al., 1983) had already divided its symptoms into the two factors which laid the foundations for the diagnostic taxonomy of GAD in the DSM and ICD; worry and emotionality. Borkovec et al. defined worry as "a chain of thoughts and images, negatively affect-laden and relatively uncontrollable… an attempt to engage in mental problem-solving on an issue whose outcome is uncertain but contains the possibility of one or more negative outcomes" (p. 10). The worry factor (apprehensive expectation) is the hallmark symptom of GAD and is mainly distinguished from non-pathological worry by the control the individual has over it. Meyer et al. (1990) showed uncontrollability of worry to be a reliable discriminating factor for high worriers with or without GAD. Emmelkamp and Ehring (2014) further argued that even severe worry does not necessarily warrant the presence of GAD, as uncontrollability and pervasiveness of worry were deemed more reliable discriminatory factors. The pervasiveness of worry, measured as frequency of thought intrusions, was also found to be higher in individuals with GAD, who were also found to have

more negative beliefs about worry, and a higher need to control thoughts, despite showing less cognitive confidence (Ruscio & Borkovec, 2004; Hirsch et al., 2013). Early research on worry had also already shown that individuals with GAD had more worry domains, including ones which may be considered as pertaining to minor issues such as household chores (Roemer et al., 1997). More recently, Hirsch and Mathews (2012) reflected that in GAD, as opposed to other disorders, worry is relatively more abstract. This was compared to rumination in the context of depression as both involve hard to control, repetitive negative thoughts about the self; rumination usually involving past events or present personal attributes, and worry usually involving a cognitive response to a perceived future threat (usually in the form of *"what if?"* questions). The generalisability of worry domains and the relentless intrusion of a myriad of worrisome thoughts is thus reflected in the name of the disorder and in the language used in the psychological diagnostic manuals (i.e., *free-floating anxiety* and *general apprehensiveness*; WHO, 2019).

It is generally agreed that function of worry is one of cognitive avoidance towards threatening information. However, the tendency to rely on excessive, repetitive, and uncontrollable thoughts to distance oneself from negative material is seldom an effective strategy of internal control. Apprehensive expectation is a timely and cognitively taxing endeavour; the constant worry deflects attention from the present moment to an anxiety-provoking future threat. This not only disrupts the present attentional capacity of the individual, but it also makes it less likely for the individual to find personal satisfaction within the present moment (APA, 2022; ICD, 2019; Emmelkamp & Ehring, 2014, Hirsch & Mathews, 2012). Newman and Llera (2011) presented evidence that the avoidant function of worry is not to avoid negative imagery, but rather that worry is enacted by the individual due to the belief that it would help minimise anxiety levels in case the dreaded event occurred in the future. Whatever the function, worry sustains negative emotionality for longer than the anxiety-

provoking event (Newman et al., 2013). Pieper et al. (2010) presented evidence that physiological activity related to excessive worry (such as increased cardiovascular activity) even persisted when GAD patients were asleep, a factor contributing to sleep disturbance. Olatunji et al. (2011) found a heightened reactivity to neutral and ambiguous stimuli (similar to the reactivity to negative ones) in individuals with GAD, a result which also reflected evidence of longer periods of physiological activity.

The second factor initially described by Borkovec et al. (1983), emotionality, referred to the feeling states and physiological activation which resulted from excessive worry. The fatigue resulting from a demanding cognitive and behavioural exploration of uncontrollable worries makes the individual vulnerable to a myriad of physiological symptoms. The ICD-11 specified that some individuals may even lament physiological symptoms without expressing worry content (WHO, 2019) whereas the DSM-5 further stressed the impairment of psychosocial functioning as a result of long-term worry. Selye's (1956) explanation of the General Adaptation Syndrome (GAS), a phenomenon which may be used to understand prolonged anxiety, fundamentally underlined another important factor that distinguishes between normal and pathological anxiety, duration. Emmelkamp and Ehring (2014) stressed the importance of having a six-month period (although exact duration remains unspecified in the ICD-11) in which anxiety is present rather than the one-month duration which was required in the DSM-III. The revision of this in the DSM-IV prevented the misdiagnosis of GAD in individuals who were going through a period of adjustment. Selye's work was a landmark study for understanding the basis for the symptoms resulting from long-term stress. The GAS fundamentally explains how as stress persists over time, the body starts to move towards exhaustion; a phenomenon which depletes the body from its ability to cope with stressors, resulting into various physiological repercussions. The consequences of prolonged anxiety correspond to the ones presented by Selye's model as prolonged anxiety leads to higher activity

of the hypothalamic-pituitary-adrenal axis and sympathetic nervous system (Cohen et al., 2015). Much of what is listed under the additional symptoms required by the DSM-5-TR and ICD-11 for the diagnosis of GAD can be traced back to this effect (see Table 1). Cohen et al.'s review further highlighted the increased incidence of coronary heart disease in individuals suffering from anxiety disorders as well as the association to poorer health behaviours (such as poor diet, smoking, alcohol consumption and lower physical exercise). Indeed, individuals with GAD in Western countries rely more heavily on the health care system (Roberge et al., 2015).

2.4 Current models for Generalised Anxiety Disorder

This subchapter presents the most influential models of GAD. Emphasis shall be made on the factors which constitute this disorder as they, together with other diagnostic criteria of GAD, constitute the foundation of the attributes used to create a formal psychological assessment of GAD in this study. This chapter follows Behar et al.'s (2009) classification of the different models in three separate clusters: cognitive models, emotional models, and an integrated model. However, the specific models chosen for each cluster differ slightly from the previous study in order to present an updated, contemporary review which also reflects the basis for the chosen attributes of this study.

2.4.1 *Avoidance Model of Worry and GAD: Integrated model of GAD*

The central tenet of the Avoidance Model of Worry and GAD (AMW; Borkovec, 1994; Borkovec et al., 2004) is that worry is a negative verbal/linguistic activity which consists of primarily thought ideation over imagery ideation (predominance of thought activity); a form of anxious self-talk. The model asserted that worry favours accessibility to cognitive thoughts at the expense of more vivid and emotionally distressing imagery. This produces less sympathetic activation and precludes emotional processing, hence negatively reinforcing an avoidant response to perceived threat.

AMW posits that anticipating a problem through worry is an ineffective attempt of the individual to problem solve whilst avoiding the intense cognitive and physiological response to the negative imagery produced by a threat (Borkovec et al., 2004). Worry requires great amounts of attentional resources which could be better directed towards emotional processing. This provides the individual with a distraction from the threat, at the same time, it inhibits the emotional processing needed to extinguish the anxiety/fear of the anticipated outcome. As a result, anxious meanings increase and worry is maintained, thereby incubating a maladaptive anxious response to an increasing number of worry domains (linking the model to generalised anxiety). Hence, repetitive and abstract worries would increase anxiety levels for longer periods of time despite worry episodes being less pronounced than the fearful response which would otherwise naturally occur in the form of mental imagery. In such cases, worry episodes may become so generalised/abstract that even little emotional response would trigger them (Borkovec & Inz, 1990). On this note, Roemer and Borkovec (1994) found that suppression of neutral thought (besides negative thought) also resulted in increased anxiety values for the suppressed thought.

The AMW proposed that worry also functions as a mechanism of cognitive avoidance due to its inhibition of sympathetic activation. Borkovec et al., (2004) argued that images of threatening material would trigger a more heightened sympathetic response (similarly to other anxiety disorders) than verbal-linguistic worry. Particularly, it was proposed that cardiovascular responses were relatively inhibited during worry episodes (Borkovec et al., 1993; Nelson & Harvey, 2002). However, this notion remains theoretical due to limited findings and contrasting literature (Behar & Borkovec, 2020). In another study, trait worry was shown to increase sympathetic responses including cardiovascular activity (Pieper et al. 2010). Behar and Borkovec (2020) recently added that, despite the findings that worry did in fact increase initial levels of fear responses upon repeated exposures, physiological activation

decreases. This finding was integrated with the supposition that anxious meaning is maintained and increases over time.

Another fundamental aspect of the AMW which is shared with the Intolerance of Uncertainty Model (IUM; Dugas et al., 1995) and the Metacognitive Model of Anxiety (MCM; Wells, 1995, 1999) are worry beliefs. The AMW proposed that positive beliefs about worry maintain and strengthen the tendency towards it. Sibrava and Borkovec (2006) stressed the importance of early therapeutic identification of any beliefs which may be maintaining worry in order to proceed with a psychological intervention. Borkovec et al.'s (1999) work on positive beliefs about worry identified 6 main worry beliefs: (1) worry provides a space to trouble-shoot possible avoidant techniques or solutions to an issue; (2) worry minimises the likelihood of the anticipated event; (3) worry helps distract from emotionally-distressing thoughts; (4) worry prepares us for the anticipated event; (5) worry functions as a motivator to get things done; (6) worry is a good problem-solving strategy. Furthermore, each time that an anticipated worry does not occur or turns out better than expected, the belief that worry somehow has an important role in moderating anxiety towards an event is strengthened (a reinforcement which happens together with the proposed sympathetic inhibition discussed above). Hence, recognising worry beliefs which may hinder positive change in GAD clients is imperative to break the vicious cycle maintaining GAD.

Finally, the AMW also underlined the significance of interpersonal worries in GAD (Borkovec et al., 2004; Roemer et al., 1997). It was observed that GAD clients tend to hold several interpersonal worries and that this tendency may trace its origins to their upbringing. Bowlby (1973) had already observed the effects of parental availability over child anxiety. The AMW hypothesised that an insecure attachment would cause the child to perceive the world as a dangerous place in which hyper-vigilance and anticipation of future threats are necessary (Sibrava & Borkovec, 2006). This is supported by the findings that negative parenting

behaviours were associated with GAD symptoms and that dysfunctional interpersonal strategies may maintain or onset GAD (Cassidy et al., 2009; Newman & Erickson, 2010). Thus, it has been hypothesised that worry may also have the function of anticipating the needs of others for the purpose of fulfilling an unresolved tendency towards receiving positive affect from significant others.

2.4.2 Cognitive models

Cognitive Model of Pathological Worry

A model of anxiety which assumes an avoidant response to an anxious stimulus automatically assumes that threat detection has a central role in anxious behaviour; threat detection precedes an avoidant response. The Cognitive Model of Pathological Worry and GAD (CMPW; Hirsch & Matthews, 2012) is a relatively new model which proposed that emotional processing biases and attentional control exacerbate and maintain pathological worry. This hypothesis has been supported by Goodwin et al.'s (2017) review on GAD, worry, and attention to threat stressed important evidence of a biased attentional control in GAD clients. Furthermore, Van Bockstaele et al. (2014) added that: "the relation between attentional bias and fear and anxiety is best described as a bidirectional, maintaining, or mutually reinforcing relation." (page 682).

High levels of worry and anxiety in the CMPW, are a result of a cognitive hypervigilance which can be traced back to two main factors. Firstly, Hirsch and Matthews (2012) observed an association between high levels of worry and an emotional bias in interpreting events as threatening, even when such an event may be uncertain. This bias is subject to conscious and unconscious processes; unconsciously, an intruding thought may initiate an anxious reaction (even through automatic processes or processes of habituation) which is then maintained by conscious processing. The second factor which may cause cognitive hypervigilance in GAD clients is the impairment of attentional control. The CMPW

underlined how the inability to control or ignore distracting information arising from bottom-up processes is a result of an impaired top-down control over non-pathological worries. On this note, similarly to the AMW, Hirsch and Matthews recognised that worry negatively effects the individual's control over anxious information, hence incubating anxiety.

Hirsch and Matthews asserted that in non-anxious individuals, bottom-up influences (such as external stimuli outside of our control which grab our attention) are not strong enough to trigger a response to threat. On the other hand, anxious individuals would not only be more vigilant to threats but would also have less effective emotional processing strategies, making it harder to inhibit the anxious cue via top-down attentional processing. If the attentional bias towards anxious material is succeeded by an inhibition of top-down processes (which regulate the attentional control over intrusive thoughts), attention towards negative, intrusive thoughts is reinforced, thus fulfilling a self-sustaining worry cycle. It is important to note that bias to threat is stronger, more verbal-linguistic (as opposed to imagery - parallel to the AMW) and has more general worry domains in GAD clients. It has been suggested that having more general verbal-linguistic worries may contribute to the greater frequency of thought intrusions experienced by worriers and that the attentional bias towards threatening material is evident across generalised worry domains (Goodwin et al., 2017).

Metacognitive Model of Anxiety

The Metacognitive Model of Anxiety (MCM; Wells, 1995, 1999) proposed the existence of two types of worry; Worry 1 and Worry 2. According to the model, worry 1 is not regarded as being intrusive or in any way persistent; it is a non-pathological anxious response to a negative event. On the other hand, worry 2 (i.e., meta-worry) is a pathological anxious response arising from the stimulation of type 1 worry. The transition from worry 1 to worry 2 is defined by the MCM as a form of negative appraisal of worry in which the individual would 'create' worry about worry. Meta-cognitive worries have two main domains (Wells & King,

2006). The first one regards worry about its uncontrollability, this may be observed through negative thought intrusions such as "I am losing control" (Wells, 2011, p. 93). Secondly, meta-worry elicits strong anxious responses regarding the physical, psychological, and social functioning which may manifest itself as negative appraisals regarding the individual's bodily response to anxiety.

Similarly to the AMW and the Intolerance of Uncertainty Model, the MCM observed that pathological worry is accompanied by negative and positive beliefs about worry (Wells, 1995, 1999). Negative beliefs about worry are the ones which elicit the problematic response of meta-worry and mainly consist of the two main domains of worry 2, these beliefs worsen anxious symptoms and diminish the ability of the individual to cope with what would otherwise be considered non-pathological anxiety. On the other hand, positive beliefs about worry serve to strengthen the reliance on worry to cope with type 1 worry and are reinforced by the events in which maladaptive coping mechanisms such as avoidance or suppression are successful. The coexistence of both negative and positive beliefs about worry is defined by the model as a state of *meta-cognitive dissonance* which warrants the presence of pathological anxiety. Once meta-worry develops, the symptomatology of GAD is likely to worsen as this fulfils a vicious cycle. Coping mechanisms for meta-worry (such as avoidance and reassurance seeking) tend to maintain negative appraisals and do not challenge beliefs about worry, this increases the tendency of the individual to rely on external factors as opposed to internal mechanisms of coping. Meta-worry not only increases anxious meanings and strengthens the tendency to rely on maladaptive coping mechanisms (which, as the AMW proposed, limits the possibility of extinction through emotional processing), but it also provides the individual with more worry content, which would subsequently increase meta-worry and automates a repetitive process which progressively worsens the individual's tendency to meta-worry.

Meta-cognitive therapy (MCT) for GAD, which was developed on the theoretical foundations of the MCM, has shown very promising results. The main focus of MCT is to recognise metacognitive beliefs about worry to eventually regulate negative appraisals of worry and use more functional coping mechanisms rather than employing external control strategies (Wells, 2006, 2011; Nordahl et al., 2018). Its efficacy has been demonstrated by an open-trial (Wells & King, 2006) and by randomised controlled trials (RCT; van der Heiden et al., 2012; Nordahl et al., 2018). Van de Heiden et al.'s RCT yielded promising results for MCT and intolerance of uncertainty therapy (IUT) for GAD symptoms as remissions after a maximum of fourteen session were 91% and 80% respectively. Furthermore, Nordahl et al. presented evidence that MCT had higher recovery rates from GAD than cognitive-behavioural therapy (65% for MCT and 38% for IUT).

Intolerance of Uncertainty Model.

The Intolerance of Uncertainty Model (IUM; Dugas et al., 1995; Dugas et al., 1998) is a growing model for understanding a dispositional characteristic to worry and GAD. Intolerance of uncertainty (IU) has been shown to be a key characteristic of GAD (Dugas et al., 1998; Dugas et al., 2007; Koerner & Dugas, 2008). Despite its origins as a model for worry, IU has been proposed to be a transdiagnostic process associated with many more psychiatric disorders such as: obsessive-compulsive disorder, depression, and social anxiety disorder (e.g., Holaway et al., 2006; Carleton et al., 2010; Gentes & Ruscio, 2011). Due to the nature of this study, this chapter has been limited to the IUM's theoretical implications for worry and GAD. Furthermore, it is also important to note that despite its various theoretical applications, IU has shown a strong and specific relation to GAD (Robichaud, 2013).

At its most fundamental level, IU is a cognitive filter which presents a *fear of the unknown* (Carleton, 2016). IU has been described as a "dispositional characteristic that reflects a set of negative beliefs about uncertainty and its implications" (Robichaud & Dugas, 2012, p.

24). In essence, IU was defined as a cognitive schema by which an anxious individual might understand the environment in a way which maximises perceptions of threat when the outcomes and possibilities promised by the environment are not fully certain. As a result of IU, the individual is hypothesised to react in a way which exacerbates and maintains anxiety (Dugas et al., 1998). The IUM addresses worry to be a result of IU. Worrying would be favoured by the patient's cognitive bias towards negative outcomes (which are often uncertain) and would be used as a coping mechanism aimed at avoiding anxious stimuli in the form of uncertain situations. Similarly to the AMW, IUM acknowledged the influence of positive beliefs about worry and negative beliefs about uncertainty on reinforcing worry as a coping mechanism (Dugas et al., 2004; Hebert et al., 2014). IU is thus understood to sustain worry by reinforcing positive beliefs aimed at avoiding a more intense anxious response due to uncertainty (Freeston et al., 1994).

The IUM also acknowledged a component of negative problem-solving orientation within its model (Dugas et al., 1995; Dugas et al., 1997; Robichaud & Dugas, 2012). Being vulnerable to perceiving uncertain situations as threatening would predispose an individual to reacting to a problem situation with anxiety. In such a situation, individuals who are intolerant of uncertainty are unlikely to predict positive or even neutral outcomes to an uncertain situation which would require a certain degree of decisional capacity. Even once we forgo the tendency of GAD patients to avoid negative, uncertain thoughts with worry and other negative coping mechanisms (as stipulated by the AMW), anxious individuals are unlikely to predict a positive outcome to such a situation and are likely to have low levels of confidence in problem solving.

Finally, cognitive behavioural therapy targeting IU in GAD (CBT-IU) has shown promising results both during treatment for GAD and after a one-year follow-up (Ladouceur et al., 2000). More recently, Zemestani et al. (2021) found that CBT-IU was as effective as selective serotonin reuptake inhibitors (SSRIs) in treating GAD and that CBT-IU had

significantly better results post-treatment. Furthermore, Hebert and Dugas (2019) found that behavioural experiments which tested personal beliefs about uncertainty (done within a therapeutic setting) yielded positive changes in GAD symptoms and IU. It was suggested that such experiments serve the function of weakening beliefs about uncertainty and replace them with neutral or positive beliefs. It could be concluded that promising results about therapy targeting IU favours the IUM as a central model for GAD and provides further evidence for the centrality of IU and its associated characteristics (avoidance, negative problem orientation, and positive beliefs about worry) within GAD.

2.4.3 *Emotional Dysregulation Model: Emotional model of GAD*

The Emotional Dysregulation Model (EDM; Mennin et al., 2002, 2005) stems out from the AMW in that it shares the notion that worry and anxiety are accompanied by a motivation to avoid emotionally distressing experiences. The EDM proposed that a model was needed to understand the drive behind the avoidant motivation. What Mennin et al. proposed was that GAD clients tend to have a difficulty understanding, modulating, and reacting to emotions. The fundamental issue of GAD was initially twofold: (1) GAD clients show deficits of emotional regulation, (2) the inability to self-regulate aversive stimuli was responded to with attempts to control and/or avoid intrusive thoughts. In other words, emotions are picked up by GAD patients as being subjectively aversive and this leads to favour the tendency to control and/or avoid negative emotional experiences through worry. Similarly to AMW, Mennin et al. held that negative cognitive control strategies such as worry happen at the expense of emotional regulation which may otherwise extinguish or diminish anxious meanings. The EDM further proposed that the negative approach to interpersonal relationships frequently presented by GAD clients (as discussed by the AMW) is another example of a maladaptive strategy employed at regulating emotion. Mennin et al. (2004) argued that GAD clients tend to regulate anticipated negative emotions in interpersonal relationships by approaching them in ways

which maximise feelings of security at the expense of deploying an inflexible, unnatural approach.

The EDM has shown strong theoretical support. Research exploring the neural basis for emotional dysregulation has found that reduced fronto-limbic structural connectivity in individuals assessed with GAD may be implied in deficits of emotional regulation (Tromp et al., 2012). Furthermore, a study of EEG gamma spectral power distributions during worry inductions provided evidence for heightened negative emotion during worry in GAD patients as opposed to individuals without GAD (Oathes et al., 2008). Finally, EDM presented four main components to emotional dysregulation: GAD patients (1) experience emotions as being more intense, (2) have a poorer understanding of them, (3) have a tendency to react negatively to their own emotional state, and (4) have maladaptive ways of modulating emotions (Mennin et al., 2005; Mennin et al., 2007). These components were targeted by an open trial for emotional regulation therapy which yielded promising results. GAD patients showed clinically significant improvements in the severity of their symptoms, impairment, and their quality of life which were maintained over a nine-month follow-up (Mennin et al., 2015).

Chapter 3: Formal Psychological Assessment

3.1   Introduction

This chapter opens a discussion about how the current psychological assessment method could benefit from adaptive testing methodologies such as Formal Psychological Assessment (FPA; Spoto, 2011; Spoto et al., 2013, 2018; Bottesi et al., 2015; Serra et al., 2015, 2017). FPA is a growing psychometric methodology which aims to maximise the information which is gathered by tests and semi-structured interviews. A summary of the literature about FPA and its applicability is provided. In addition, the mathematical concepts which FPA is based upon: Knowledge Space Theory and Formal Concept Analysis are explained.

3.2   Moving beyond traditional psychological assessment

Psychological assessment, usually conducted in the form of a clinical interview, is amongst the first steps towards helping a client (Groth-Marnat, 2009). Information about the client's well-being is traditionally collected through the use of semi-structured interviews and/or psychometric questionnaires. These two methods, however, have their limitations; particularly, they can be time-consuming and/or non-exhaustive. Semi-structured interviews are the most adaptive of the two methods. These types of standardised instruments (e.g., the Structured Clinical Interview for the DSM; First, 2014) consist of a myriad of items (i.e., questions) which the clinician would move through on basis of the answers previously given by the client. Groth-Marnat (2009) pointed out that semistructured interviews are relatively more subject to bias by clinician as well as being time-consuming.

FPA proposes the application of the adaptability of semi-structured interviews, amongst other things, to questionnaires whilst retaining their less time-consuming nature and validity (Spoto et al., 2013). Traditional questionnaires, although time-efficient, also have some issues. Gibbons et al. (1985) reflected that scoring tests per item implicitly suggests that different items have equal weight for a diagnosis. Such methods could not only misinterpret the severity of the

clients' symptoms but may also fail to elaborate on the individualistic manifestation of symptoms (Meyer et al., 2001). Borsboom and Cramer (2013) argued that a network approach to psychopathology permits the clinician to construct an individual case of the client. Such an approach assumes that symptoms and criteria (i.e., attributes) make up the *network* which a mental disorder consists of. Hence, under this approach, symptoms are the driving factor towards mental illness rather than being a mere result of mental illness (e.g., excessive worry and the attempt to avoid it may lead to GAD; Borkovec & Int, 1990). Under this consideration, the authors argued that psychometric assessments should indeed focus on a broader perspective of symptoms rather than on a general summation of the clients' condition, such as is the case with cut-off scores in questionnaires. FPA tackles this issue through an approach which links item responses to the attributes of a theoretical construct such as GAD (Spoto et al., 2010).

3.3   Formal Psychological Assessment

A central aspect in the discipline of psychometrics is that of defining the relationship between observable responses (such as answers to psychometric tests/questionnaires) and the theoretical constructs making sense of them (Borsboom and Molenaar, 2015). However, as highlighted by Marsman et al. (2018), the scientific literature about construct-response relationships is rather limited in the field of psychometrics. Formal Psychological Assessment (FPA; Spoto, 2011; Spoto et al., 2013, 2018; Bottesi et al., 2015; Serra et al., 2015, 2017) attempts to bridge this gap by developing psychometric tools which do not forgo the relationship between the specific items of psychometric questionnaires and the clinical features presented by an individual when analysing responses.

FPA is a recent approach to assessment which aims to provide adaptive measurements of individual responses in relation to the theoretical construct being assessed by maximising the information which is generally gathered by tests and semi-structured interviews. A numerical conversion of an individual's responses to the administered assessment method

allows for the development of a system based on theoretical models which links the responses to the attributes which make up a theoretical construct (such as the diagnostic criteria for GAD presented in chapter 2). The importance of exploring the attributes highlighted by specific test items has also been proposed elsewhere. Marsman et al. (2018) argued that theoretical constructs are to be considered by network analysis as clusters of *behaviour domains* in order to avoid missing behaviours which are present in the clinical case, but which would not be picked up by an aggregated score on a test assessing a general construct. In parallel, Spoto et al. (2013) argued that FPA allows the clinician to move beyond the cut-off scores of a test and obtain a clearer picture of the clinical case which would be sensitive to the individual's response patterns.

Rather than focusing on the scores, FPA focuses on the *attributes* (i.e., diagnostic features or symptoms) implicated by affirmative answers to test items (Serra et al., 2015). In this way, two different clients who get the same score on a psychometric test would still retain their individual differences. Spoto et al. (2013) highlighted that by analysing the relationships between items and attributes one may construct a deterministic model which eliminates redundancies (i.e., items checking for the same attribute) and grants theoretical flexibility to the clinician. Currently, the only other way to obtain similar possibilities from a questionnaire would be to either analyse each individual response given by the patient or by conducting a clinical interview; in both cases, the benefit of questionnaires taking less time to administer and analyse is annulled.

In order to be able to determine the relationship between the chosen theoretical construct and the items on a collected number of psychometric tools (mostly in the form of questionnaires), an a priori analysis of the theoretical constructs' clinical features is required (Serra et al., 2015). In this study, Chapter 2 has investigated the current literature highlighting the features of GAD in order to present an exhaustive representation of what attributes make

up this disorder. The review of the literature pertaining to a theoretical construct is what permits the FPA to construct the clinical structure of the chosen construct in the form of a Boolean Matrix as it provides a theoretical foundation for the attributes chosen to warrant the presence (or not) of a clinical diagnosis. This allows for a binary representation of the relationship between a test item and the chosen attributes, denoted by a '1' whenever the relationship holds and by '0' when the item does not investigate the attribute. Once a clinical structure is defined, it is possible to create a deterministic skeleton on which a probabilistic model for individual responses may operate in an adaptive manner. This would allow for making use of previous answers to determine what will be asked next, similarly to what a clinician would do during a semi-structured interview, but in the form of a more time-efficient questionnaire (Spoto et al., 2010). The framework for FPA and the construction of a probabilistic network is based on the mathematical concepts of Knowledge Space Theory (Doignon & Falmagne, 1999) and Formal Concept Analysis (Ganter & Wille, 1999; Wille, 1982).

3.4   Knowledge Space Theory and Formal Concept Analysis

Knowledge Space Theory (KST; Doignon & Falmagne, 1999) is a set of concepts which was initially developed to assess the knowledge of a learner about a particular subject. Items evaluating the individual's knowledge are sorted by difficulty and are split into different categories. The whole set of items which may assess for potential knowledge is called a knowledge domain (i.e., clinical domain in FPA) and is denoted by Q, whereas the subset of items *belonging* to the individual is called a knowledge state (i.e., clinical state in FPA) and is denoted by K (formally, $K \subseteq Q$). In other words, a knowledge state in KST is the particular subset of skills out of the whole knowledge domain which the individual has achieved.

KST argues for the creation of a skill map; formally (Q, S, f), where Q represents the knowledge domain, S represents a nonempty set of skills, and f is a mapping from Q to $2^S \setminus \{\emptyset\}$ (Doignon & Falmagne, 1999). In this way, solving item q demonstrates understanding of the

skills leading up to it. In FPA, *S* represents the clinical symptoms which are associated with the theoretical concept. Hence, within the framework of FPA, items are not sorted by difficulty but rather by prerequisite relations, which allows for the application of admissible response patterns (ARPs) to adaptive testing. In other words, not all combinations of answers (i.e., knowledge states) can hold logically; for instance, an individual who does not have problematic worry episodes would reasonably implicate that he is not generally troubled by meta-worry (i.e., worry about worry). The combination of all possible knowledge states is referred to by KST as a knowledge structure (Q, $\mathcal{K}$) where $\mathcal{K}$ denotes the collection of all possible knowledge structures within a knowledge domain *Q*. An example of a possible knowledge structure in which *a* would be a prerequisite for *b* and *c* would be denoted as:

$$\mathcal{K} = \{\emptyset, \{a\}, \{a, b\}, \{a, c\}, \{a, b, c\}\}$$

Finally, a knowledge structure, although theoretically valid, does not depict reality accurately enough for the creation of a deterministic, adaptive model. Hence, a probabilistic knowledge structure is later used for the allocation of the probabilities for false negatives and false positives through the use of a Basic Local Independence Model (BLIM; Doignon & Falmagne, 1999).

The second mathematical concept which has been applied to FPA is Formal Concept Analysis (FCA; Ganter & Wille, 1999; Wille, 1982). Broadly speaking, FCA is a way of analysing the relationships between objects and the set of attributes which the objects consist of. The relationship between objects and attributes is called a formal context (i.e., clinical context in FPA) and is denoted formally as: (G, M, I) where *G* represents the objects, *M* represents the attributes, and *I* is the binary relation between *G* and *M*. A formal context is generally represented by a Boolean Matrix in the form of a table where the columns represent the different attributes, and each row represents different objects. In the case that object *g* has

attribute *m* then it is said that the relation *gIm* holds and is denoted with a '1' in the matrix. In the case that it does not hold, it is said that the relation *gIm* does not hold and is denoted with a '0'. The second important concept in FCA is the formal concept (i.e., clinical concept in FPA), formally (A, B). Mathematically, the pair (A, B) is a formal concept of (G, M, I) only if:

$$A': = \{m \in M \mid gIm \; \forall \; g \in A\}$$

$$B': = \{g \in G \mid gIm \; \forall \; m \in B\}$$

In words, a formal concept represents all the data sets of the formal context which are in pair; hence, all the attributes shared by objects in *A'* and dually, all the objects shared by attributes in *B'* are identical.

Both KST and FCA frameworks are combined under FPA to provide a new perspective to adaptive testing. The creation of a knowledge structure within a formal context provides the possibility to apply prerequisite relations between objects and attributes. In FPA, the conjunctive model of KST is used to more deeply assess the relationships between different objects (Doignon & Falmagne, 1999; Spoto, 2011). The conjunctive model assumes that positive responses to items automatically endorse all the attributes related to said items. In this way, affirmative answers to a test item endorsing, for instance attributes *x* and *y,* would suggest that the individual would also provide affirmative answers to items endorsing the same attributes separately. Hence, a conjunctive model would open the possibility for applying ARPs into an adaptive framework.

3.5   Conclusion

This chapter presented the theoretical foundations for FPA and its potential applications. The next chapter shall apply FPA to current psychometric tools in order to construct a clinical context for GAD. As per the FPA framework, the clinical context, represented by a Boolean Matrix, builds a clinical structure which provides both quantitative

(i.e., the general score to the combination of psychometric items) and qualitative (i.e. the clinical state of the client specified by the attributes she or he endorses) information about the individual case (Bottesi et al., 2015).

Chapter 4: Application of Formal Psychological Assessment

4.1 Introduction

The aim of this study is to apply the framework of Formal Psychological Assessment (FPA; Spoto, 2011; Spoto et al., 2013, 2018; Bottesi et al., 2015; Serra et al., 2015, 2017) to the assessment of Generalised Anxiety Disorder (GAD). This chapter explains the procedure for constructing a clinical context and presents the results in the form of a refined set of items which should theoretically assess all the attributes deemed central to the diagnosis of GAD without redundant items. This creates the possibility to apply the refined clinical context to an adaptive structure which relies on response patterns.

4.2 Procedure

As per FPA, the central feature for the development of a psychometric instrument is the construction of the domain of the clinical context for the chosen theoretical concept (e.g., Spoto et al., 2013; Serra et al., 2015). The clinical domain is represented in table form where each row represents a different item, and each column represents a different attribute. The cells where attributes and items meet are labelled in binary fashion and can either contain a '1' if there is a relationship between items or a '0' if there is not (an example is presented in Table 4.3).

This study's clinical domain evaluated the relationship between 19 attributes for GAD and 138 items chosen from eight psychometric tools. The obtained clinical context was then refined by eliminating redundant and/or irrelevant items. The refinement process led to a set of 39 items from the initial 138 items; each of which analyses different combinations of attributes. Finally, three *ad hoc* items were created and added to the clinical context, completing an exhaustive set of 42 items.

4.2.1 Choice of psychometric tools

Seven self-evaluation questionnaires and one clinical rating scale developed in English were chosen for the construction of the Boolean matrix. Reliable short forms of the questionnaires were favoured in this study as redundant items would have already been eliminated by previous research. Each of the psychometric tools are presented below.

- The Generalized Anxiety Disorder 7-Item (GAD-7; Spitzer et al., 2006) is an excellent screening tool for GAD and other anxiety disorders. This self-report anxiety questionnaire measures the frequency of anxious behaviours which the individual would have experienced over the previous two weeks. The GAD-7 was developed as a brief scale to assess for probable cases of GAD and to assess the severity of symptoms; higher scores were strongly associated with a higher degree of functional impairment across multiple domains (Spitzer et al., 2006). GAD-7 has demonstrated 89% sensitivity and 82% specificity for GAD (Williams, 2014). However, since GAD-7 is primarily a screening measure, probable cases should be confirmed through other assessment methods. This makes the GAD-7 an excellent tool to be incorporated within the Boolean Matrix of this study as it would be complemented by more specific items from other psychometric tools.

- The Beck Anxiety Inventory (BAI; Beck et al., 1988) is a widely used self-report inventory that measures the severity of common symptoms of anxiety disorders. This inventory consists of 21 items which investigate anxious symptoms over the past week, each item is rated by the patient across a 4-point scale. The BAI distinguished between anxious groups (i.e., patients suffering from an anxiety disorder) and non-anxious groups. This inventory has shown high internal consistency ($\alpha = 0.92$) and test-retest reliability over one week (r (81) = 0.75; Beck et al., 1988). It is important to note that this inventory does not specifically investigate GAD, rather it investigates a cluster of

symptoms pertinent to separate anxiety disorders. This provided an opportunity to add different items which would be more pronounced in other anxiety disorders but would still classify as attributes of GAD.

- The Anxiety Sensitivity Index-3 (ASI-3; Taylor et al., 2007) assesses anxiety sensitivity (AS). AS has been identified as a predisposing factor in the development of numerous anxiety disorders amongst which is GAD (Reiss et al., 1986). AS was originally defined by Reiss et al. as a discomfort arising from the sensation of anxious arousal due to the belief that such a sensation could have adverse consequences for the well-being of the individual. AS was originally measured through the Anxiety Sensitivity Index (ASI; Reiss et al., 1986) and was more recently adapted by Taylor et al. (ASI-3; 2007) to incorporate a multidimensional approach which involves the three separate components of AS (i.e., physical, cognitive, and social). This factor has been identified as a transdiagnostic measure for anxiety disorders and all components were found to be related to GAD (Boswell et al., 2013; Naragon-Gainey, 2010). Reiss et al. suggested that AS would make way for an aversive reaction to anxious feelings, theoretically causing a higher level of worry and anticipation of threat; factors central to the development of GAD. This research believes that the construct of AS is, in this respect, similar to the factor of meta-worry proposed by the Meta-cognitive Model of Anxiety (Wells, 1995). Combining both models, one may conclude that a strong anxious response to anxious arousal due to the belief that this may have adverse consequences for the individual precedes the reinforcement of worrisome reactions (i.e., aversion) which exacerbate the anxious response to an anticipated negative event. The ASI-3 was chosen as one of the tests to be included in this study due to its reliability (α scores ranging from 0.73 to 0.91), good convergent, discriminant, and criterion-related validity (Taylor et al., 2007). Moreover, Viana and Rabian (2008) found evidence of a

significant relationship between AS and GAD symptoms. The authors highlighted that individuals with GAD had more adverse reactions to anxiety-related sensations (such as increased cardiovascular activity). Finally, cognitive and social components of AS were found to be more strongly to GAD than the physical component of AS (Naragon-Gainey, 2010). However, considering recent findings supporting the unidimensionality of the structure of the ASI-3 (Ghisi et al., 2016); all three components of the ASI-3 were included in the Boolean Matrix.

- The Hamilton Rating Scale for Anxiety (HAM-A; Hamilton, 1959) is a clinical rating scale for anxiety consisting of 14 items which assess different symptoms of anxiety in a general manner. The items of the HAM-A are not presented in question form but rather in a list of possible manifestations of an anxious symptom, which the clinician would have assessed during an interview (i.e., anxious mood, tension, fears, etc.). This scale offers systematic and concise items for specific symptoms of GAD (such as sleep disturbances, which were not assessed by the other psychometric tools presented in this study). Although arguably outdated (for instance, HAM-A assesses worry briefly and superficially despite it being a multifaceted, hallmark symptom of GAD, which is also present in other anxiety disorders), this psychometric tool was an important addition to the clinical domain of this study as its items were not limited by linguistic factors and could therefore investigate certain aspects of GAD more freely.

- The Worry Domains Questionnaire – Short Form (WDQ-SF; Stöber & Joormann, 2001) is a shorter version of Worry Domain Questionnaire (WDQ; Tallis et al., 1992). The WDQ-SF is a self-report questionnaire comprising of 10 items which assess the worry content of an individual. Stöber and Joormann highlighted that the WDQ-SF is a good measure for assessing worry more broadly. The WDQ, which the WDQ-SF shares an excellent correlation with ($r = 0.97$; Stöber & Joormann, 2001), assesses worry across

5 main subscales (i.e., relationships, aimless future, financial worries, work incompetence, and relationship worries). This distinguishes the WDQ from other psychometric tools for assessing worry which tend to focus on the frequency of worry (i.e., Penn State Worry Questionnaire). Finally, the WDQ was proven to be a valid and reliable test having a test-retest stability across four weeks and high internal consistency ($\alpha > 0.90$; Stöber, 1998)

- The Penn State Worry Questionnaire (PSWQ; Meyer et al., 1990) is a widely used self-report questionnaire which assesses pathological worry (Molina & Borkovec, 1994; Behar et al., 2003). Furthermore, the PSWQ was also found to be an accurate screening measure for GAD. Indeed, the PSWQ was found to discriminate between clinical and non-clinical cases of GAD (Behar et al., 2003). The PSWQ is made up of 16 items which assess a myriad of features pertinent to pathological worry. Molina and Borkovec pointed out that these items assess the generalisability of worry, the excessiveness, and the uncontrollability of worry, all these factors are in some way highlighted by the different attributes chosen in the current study. The PSWQ is a valid and reliable test; having high internal consistency and test-retest reliability (Cronbach's alphas are on average 0.90; Molina & Borkovec, 1994). Finally, the PSWQ was also proven to discriminate between normal controls and GAD clients, showing good validity (Brown et al., 1992).

- The Depression Anxiety and Stress Scales - 21 (DASS-21; Lovibond & Lovibond, 1995) is a shorter version of the DASS-42 and is a self-report questionnaire which assesses three separate scales: depression, anxiety, and stress (Lovibond & Lovibond, 1995). This questionnaire is composed of 21 items (seven items for each scale) scored on a 4-point scale based on how frequently the item in question applies to the individual. Nevertheless, Osman et al. (2012) argued that the DASS-21 assesses general

psychological distress rather than its three separate scales. The authors further found that total scores (as opposed to three separate scores for individual domains) correlated with mixed anxiety and depression scores more highly than did the scores specific to depression and anxiety scales of other measures used to assess concurrent validity of the DASS-21. For this reason, all the items of the DASS-21 were considered in this study. On the other hand, Henry and Crawford's (2005) confirmatory factor analysis not only found high internal consistency ($\alpha = 0.90$; for the anxiety scale) and adequate construct validity for the DASS-21, but they argued that the separate scales of the DASS-21 contain enough variance to exist as separate scales (despite their common factor of general psychological distress). This contrasting evidence suggests that despite its practical applicability practice as a general measure for psychological distress, DASS-21 items still measure the component of anxiety individually, warranting its potential inclusion in the clinical domain.

- The Metacognitions Questionnaire-30 (MCQ-30; Wells & Cartwright-Hatton, 2004) is a short-form version of the Metacognitions Questionnaire (MCQ; Cartwright-Hatton & Wells, 1997). The short-form version of the MCQ was shown to have good internal-consistency (Cronbach's alphas ranged from 0.72 to 0.93) and a consistent factor structure with the MCQ (Wells & Cartwright-Hatton, 2004). The MCQ-30 is a measure for the metacognitive components (namely: negative and positive beliefs about worry, cognitive self-consciousness and confidence, and need for control) addressed by the Meta-Cognitive Model of Psychopathology (Wells, 1995, 1999) which were also essential to the construction of the attributes table (see Table 4.1). Wells and Carter (2001) found that items in the MCQ assessing negative beliefs about worry distinguished GAD patients from patients with other anxiety disorder. This supports the inclusion of the MCQ-30 in this study's clinical domain as it provides a list of items

which may be specific to GAD patients besides also having items which assess for components of GAD present in the list of attributes chosen by this study.

4.2.2   Choice of attributes

The selection of attributes was based on the review of the literature pertaining to the theoretical construct of GAD. This study analysed the prominent models of GAD in the current literature as well as the aetiology of GAD based on the relevant diagnostic and classification manuals. This allowed the creation of a list of attributes which items assessing for GAD should theoretically investigate (see Chapter 2 for a detailed review of the literature pertaining to GAD). The attributes for GAD chosen by this study were taken from a number of sources:

1.   A combination of both the Diagnostic and Statistical Manual of Mental Disorders (5th. ed. *text rev*.; DSM-5-TR; American Psychiatric Association; APA, 2022) and the International Statistical Classification of Diseases and Related Health Problems (11th ed.; ICD-11; World Health Organization; WHO, 2019) was chosen as the diagnostic features presented by both manuals were similar in nature.

2.   Three cognitive models of GAD: (1.) Cognitive Model of Pathological Worry and GAD (CMPW; Hirsch & Matthews, 2012); (2.) Metacognitive Model of Anxiety (MCM; Wells, 1995, 1999); (3.) Intolerance of Uncertainty Model (IUM; Dugas et al., 1995; Dugas et al., 1998).

3.   An emotional model of GAD: Emotional Dysregulation Model (EDM; Mennin et al., 2002, 2005)

4.   An integrated model of GAD: Avoidance Model of Worry and GAD (AMW; Borkovec, 1994; Borkovec et al., 2004).

Chapter 2 provides a detailed explanation of each of the models above, as well as the symptoms required to satisfy the criteria for GAD as per the DSM-5-TR (APA, 2022) and the ICD-11 (WHO, 2019). As expected, the majority of attributes were chosen from the

aforementioned criteria for GAD (the list of attributes is shown in Table 4.1). These were: uncontrollability of worry, interference of worry in daily living, persistence of worry in daily living, sleep disturbance, lack of concentration, irritability, restlessness and/or trouble relaxing, tension and/or nervousness, and symptoms of autonomic hyperarousal. Most of these criteria revolve around the uncontrollability and the physiological symptoms which are associated with GAD. However, both the DSM-5-TR and the ICD-11 criteria did not present much elaboration on the nature of worry. Considering this, models of GAD, worry, and anxiety were included in the formation of the list of attributes. The worry component stressed by each of the cited sources was divided into four separate attributes:

1. Content worry refers to the most generic type of worry and is similar to the concept of worry 1 highlighted by the MCM (Wells, 1995, 1999). Content worry refers to different worries which revolve around specific content and which have the potential to become pathological.

2. Interpersonal worry refers to worries about the individual's personal relationships. This distinction was made as the AMW proposed that GAD clients tend to hold several interpersonal worries (Borkovec et al., 2004; Roemer et al., 1997). This view was also shared by the EDM which proposed that GAD clients frequently present a negative approach to interpersonal relationships (Mennin et al., 2004).

3. Abstract/Multifocal worry refers to worries which do not have a specific content or which continuously switch from anxiety to another. This has been termed by the ICD-11 as "free-floating anxiety" (WHO, 2019). Abstract or multifocal worries distinguish between GAD and other anxiety disorders as the latter tend to be more specific in nature (Hirsch and Matthews, 2012)

4. Meta-worry is the second type of worry proposed by the MCM. Wells (1995, 1999) proposed that meta-worry, or worry about worry, is the pathological side to

everyday anxieties. This attribute refers to the negative appraisal of worry 1 and usually involves feelings of anxiety as a result of the individual's inability to control worry or as a result of bodily sensations arising from anxious responses. Since the uncontrollability component of worry was already covered by another more specific attribute, only the component of worry about bodily sensations arising from anxious responses was considered under this attribute.

Table 4.1. List of Attributes of the clinical context

Attribute ID	Attribute
a1	Content worry
a2	Interpersonal worry
a3	Abstract/Multifocal worry
a4	Meta-worry
a5	Avoidance
a6	Worry beliefs
a7	Intolerance of uncertainty
a8	Negative problem-solving orientation
a9	Emotional dysregulation
a10	Cognitive hypervigilance
a11	Uncontrollability of worry
a12	Interference of worry in daily living
a13	Persistence of worry in daily living
a14	Sleep disturbance
a15	Lack of concentration
a16	Irritability
a17	Restlessness and/or trouble relaxing
a18	Tension and/or nervousness
a19	Symptoms of autonomic hyperarousal

Finally, maintaining and/or exacerbating factors of GAD were also considered important to the attribute selection. Firstly, the AMW (Borkovec, 1994; Borkovec et al., 2004) proposed that worry serves an avoidant function. The attribute of avoidance refers to the tendency of the individual to avoid anxiety-provoking stimuli in any manner, as well as the tendency of the individual to rely on worry to deal with everyday stress. Furthermore, the idea

that worry beliefs are central to the development and maintaining of pathological worry and to the exacerbation of symptoms (in the case of negative beliefs) is shared by most of the chosen models (AMW; IUM; MCM; EDM). As a result, the attribute of worry beliefs was added to the list of attributes of GAD.

Aside from worry beliefs, fear of the unknown also plays an important role in the exacerbation and maintaining of GAD. Intolerance of uncertainty (IU) has shown a specific relation to GAD as it represents a way in which the individual may anticipate threat in otherwise neutral (or minimally anxiety-provoking) situations (Robichaud, 2013). The IUM also proposed that GAD clients possess a negative problem-solving orientation which is evidenced by a lack of confidence in their problem-solving capacities. The model further points out that this reduces the ability of GAD clients to deal with potentially negative situations and increases the possibility that neutral outcomes are perceived as threatening (Dugas et al., 1995; Dugas et al., 1997; Robichaud & Dugas, 2012). GAD clients have also been hypothesised by the EDM to have a difficulty understanding, modulating, and reacting to emotions (Mennin et al., 2002, 2005). This encompasses the attribute of emotional dysregulation which refers to the inability to contain, process, and/or understand emotions, often leading to the reinforcement of avoidant behaviours with respect to anxiety-provoking situations. Finally, cognitive hypervigilance refers to emotional processing biases which direct and maintain pathological worry as highlighted by the CMPW (Hirsch & Matthews, 2012).

4.2.3   Defining the clinical structure

All the items of each of the chosen psychometric tools presented above were initially considered. The rows present in the matrix reflected the items (i.e., objects) which were then analysed by the researcher. Columns *a1* to *a19* reflected the 19 attributes of GAD presented in Table 4.1. A total of 138 items were assessed to determine which attributes (if any) belonged to each item. Out of the 138 items: 8 belonged to the GAD-7, 21 belonged to the BAI, 18

belonged to the ASI-3, 14 belonged to the HAM-A, 10 belonged to the WDQ-SF, 16 belonged to the PSWQ, 21 belonged to the DASS-21, and 30 belonged to the MCQ-30. Whenever a relationship between an attribute and an item was found it was deemed that the item assesses for said attribute and was marked by a '1'. Whenever the relationship between attribute and item did not hold, it was marked by a '0' (an example of the clinical context for all the items of the GAD-7 is presented in Table 4.2.; for the complete clinical context, see Appendix A). This format allowed the researcher to create a matrix which portrayed the applicability of each item chosen from a group of widely used psychometric tools.

As per the Formal Psychological Assessment (FPA; Spoto, 2011; Spoto et al., 2013, 2018; Bottesi et al., 2015; Serra et al., 2015, 2017), once that the full clinical context was defined, each item reflected one of four possible configurations:

1. The entire row of a specific item contains only zeroes. This would mean that an item does not investigate any of the attributes of GAD and would hence, not be useful for its assessment. In this case, the item would be removed from the final domain of the clinical context. This configuration was expected to form primarily for items of tests investigating more than GAD (such as the items investigating symptoms of depression in the DASS-21).

2. Two or more items form equivalence classes. This means that both or more items investigate exactly the same set of attributes. It is important to clarify that items which investigate two or more items, of which only some are the same, do not constitute the same equivalence class (an example of this is present in Table 4.2. since items *i4* and *i5* do not constitute an equivalence class despite both of them investigate *a17*). Whenever an equivalence class forms, a prototypical item from the equivalence class was chosen to be included in the final domain of the clinical context.

Table 4.2. Example of Clinical Context for GAD-7

ID	Text	a1	a2	a3	a4	a5	a6	a7	a8	a9	a10	a11	a12	a13	a14	a15	a16	a17	a18	a19
i1	*Feeling nervous, anxious or on edge*	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	1	0
i2	*Not being able to stop or control worrying*	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
i3	*Worrying too much about different things*	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
i4	*Trouble relaxing*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
i5	*Being so restless that it is hard to sit still*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0
i6	*Becoming easily annoyed or irritable*	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0
i7	*Feeling afraid as if something awful might happen*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
i8	*...how difficult have these problems made it for you to do your work, take care of things at home, or get along with other people?*	0	0	0	0	0	0	0	0	0	0	0	1	0	0					

3. An attribute could not be investigated by any item. These cases warranted the construction of a new ad hoc item which investigates the attribute with missing items.

4. Finally, items could have problems of phrasing, construction, or validity. In these cases, items could not be considered.

Through the application of these principles, each of the relations between attributes and items were carefully analysed by the researcher to create a new domain of the clinical context which integrated different models of GAD and the items evaluating the central factors proposed by the separate models. The final domain of clinical context is presented in the form of a Boolean matrix under Table 4.3.

Table 4.3. Final Domain of the Clinical Context

ID	a1	a2	a3	a4	a5	a6	a7	a8	a9	a10	a11	a12	a13	a14	a15	a16	a17	a18	a19
i1	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	1	0
i2	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
i3	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
i6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
i8	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
i12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
i13	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
i18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
i32	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
i34	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
i38	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
i44	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
i51	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
i52	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
i60	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
i61	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0
i65	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0
i70	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
i73	0	0	0	1	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0
i75	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
i78	1	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0
i79	1	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0

i80	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
i84	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
i86	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0
i87	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
i93	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	1	0	0	0
i98	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
i106	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
i107	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1
i109	0	0	0	0	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0
i110	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
i111	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
i112	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
i113	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
i119	1	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0
i121	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
i127	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
i131	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0

4.3 Results

The final clinical context for GAD was composed of 39 items describing each of the 19 attributes. An additional 3 items were also created with the purpose of obtaining a prototypical item for each independent attribute. Through the application of the theoretical procedure of FPA for the construction of a new set of items, the Boolean matrix formed different equivalence classes (presented in Table 4.4). The procedure used to refine the initial set of items was based on a variation of the four theoretical principles of FPA presented above (Spoto, 2011; Spoto et al., 2013, 2018; Bottesi et al., 2015; Serra et al., 2015, 2017). The steps taken to produce a refined clinical context were as follows:

1. 23 items investigating no attributes from the clinical context were removed.

2. The Boolean matrix indicated the formation of 38 equivalence classes.

3. All attributes were investigated by at least one item. However, some attributes were always investigated in conjunction with another, secondary attribute. Three ad hoc items were created to investigate these attributes individually.

4. Since the remaining items were deemed to be valid and clear of construction errors, a final step was added. The 38 equivalence classes were examined, and 39 prototypical items were chosen from them. Rather than removing unclear items, only the clearest item/s from each equivalence class was maintained in the clinical context.

Since each item in the final clinical context assesses for a different set of attributes, none of the items which were kept are theoretically equal to another in the class of attributes which they investigate (with a few exceptions which are subsequently described). Through this procedure, two or more items which investigate the same attribute must also assess for different, secondary attributes. This means that each attribute can still be assessed by a number of items without any of them presenting exactly the same criteria for an affirmative answer by the client.

The central aspect of the clinical context is in fact that of representing all the prerequisite relations in the form of a Boolean matrix. This allows for a schematic representation of the subsets of attributes being investigated by other items (the mathematical representation of prerequisite relationships is explained in Chapter 3.4). The potential for an adaptive application of the clinical context presented by this study lies in the depiction of prerequisite relations. An adaptive mechanism developed as a result of this depiction would hence be able to avoid presenting items whose affirmative response would require a previous affirmative answer to an item investigating an attribute which was not endorsed by the individual being assessed. For instance, an affirmative response to item PSWQ.7 (*i78*) would theoretically depend on a previous affirmative response to item PSWQ.18 (*i84*; *see Table 4.4*)

as an individual would have to endorse the attribute of content worry before endorsing an item investigating the same attribute in conjunction with the attributes of interference and persistence of worry in daily living.

Finally, this study highlighted that none of the chosen psychometric tools assessed all of the attributes which characterise GAD, with the most common omission being items assessing for sleep disturbance, one of the critical aspects of GAD, which was only investigated by the HAM-A (APA, 2013; Hamilton, 1959). Selected items present in the refined clinical context were chosen from all psychometric tools; with the MCQ-30 having the majority of items utilised in the refined version of the clinical context (9 items). All of the attributes chosen to represent GAD were investigated by at least one of the psychometric tools. As a result, only three items needed to be added to the 39 items presented in Table 4.4.

Table 4.4. Refined set of items of the clinical context containing 39 items and 19 attributes

ID	Item	Text	Attributes
i1	GAD-7.1	Feeling nervous, anxious or on edge	*a9, a10, a18*
i2	GAD-7.2	Not being able to stop or control worrying	*a11*
i3	GAD-7.3	Worrying too much about different things	*a3*
i6	GAD-7.6	Becoming easily annoyed or irritable	*a16*
i8	GAD-7.8	…how difficult have these problems made it for you to do your work, take care of things at home, or get along with other people?	*a12*
i12	BAI.4	Unable to relax	*a17*
i13	BAI.5	Fear of worst happening	*a7*
i18	BAI.10	Nervous	*a18*
i32	ASI-3.3	It scares me when my heart beats rapidly.	*a4, a19*
i34	ASI-3.5	It scares me when I am unable to keep my mind on a task.	*a4, a15*
i38	ASI-3.9	I worry that other people will notice my anxiety.	*a2, a4*

i44	ASI-3.15	When my throat feels tight, I worry that I could choke to death.	a4, a18
i51	HAM-A.4	Insomnia: Difficulty in falling asleep, broken sleep, unsatisfying sleep and fatigue on waking, dreams, nightmares, night terrors.	a14
i52	HAM-A.5	Intellectual: Difficulty in concentration, poor memory.	a15
i60	HAM-A.13	Autonomic symptoms: Dry mouth, flushing, pallor, tendency to sweat, giddiness, tension headache, raising of hair.	a19
i61	HAM-A.14	Behaviour at interview: Fidgeting, restlessness or pacing, tremor of hands, furrowed brow, strained face, sighing or rapid respiration, facial pallor, swallowing, etc.	a17, a18
i65	WDQ-SF.4	I worry that I feel insecure	a8, a9
i70	WDQ-SF.9	I worry that I will lose close friends	a2
i73	PSWQ.2	My worries overwhelm me	a4, a9, a12
i75	PSWQ.4	Many situations make me worry	a10
i78	PSWQ.7	I am always worrying about something	a1, a12, a13
i79	PSWQ.8	I find it easy to dismiss worrisome thoughts	a1, a11, a12
i80	PSWQ.9	As soon as I finish one task, I start to worry about everything else I have to do	a3, a8
i84	PSWQ.13	I notice that I have been worrying about things	a1
i86	PSWQ.15	I worry all the time	a10, a13
i87	PSWQ.16	I worry about projects until they are all done	a8
i93	DASS-21.6	I tended to over-react to situations	a8, a9, a16
i98	DASS-21.11	I found myself getting agitated	a18, a19
i106	DASS-21.19	I was aware of the action of my heart in the absence of physical exertion (e.g. sense of heart rate increase, heart missing a beat)	a19
i107	DASS-21.20	I felt scared without any good reason	a9, a19

i109	MCQ-30.1	Worrying helps avoid future problems	a5, a6, a8
i110	MCQ-30.2	My worrying is dangerous	a4, a6
i111	MCQ-30.3	I think a lot about my thoughts	a4
i112	MCQ-30.4	Worrying can make me sick	a4, a6, a19
i113	MCQ-30.5	Aware of mind when thinking about problem	a4, a8
i119	MCQ-30.11	I cannot ignore my worrying thoughts	a1, a11, a12
i121	MCQ-30.13	I should control my thoughts all of the time	a6
i127	MCQ-30.19	Worrying helps me cope	a5, a6
i131	MCQ-30.23	Worrying helps solve problems	a6, a8

4.3.1 The clinical context

The starting set of items assessing GAD which were taken from all eight psychometric tools amounted to 138 items. As per the procedure which was previously explained, the first step was to remove the 23 items which did not possess any relation to any attribute, reducing the list of viable items for the clinical context to 115 items. Since this study involved some questionnaires which were not exclusive to the assessment of GAD, a number of items with no relation to the chosen attributes was expected. The BAI, for instance, had 4 items which could not be traced back to GAD as they involve an intense experience of panic or fear which is not usually present in GAD cases (such as items: *i17*, "terrified or afraid"; and *i24*, "fear of dying"). Symptoms investigated by these items are instead associated to panic disorder or phobic reactions rather than GAD (APA, 2013). Furthermore, 8 items from the DASS-21 did not possess any relation to the attributes of GAD as they investigated factors of depression and stress rather than anxiety (such as i108: "I felt that life was meaningless").

The Boolean matrix further served to highlight the items which assessed the same set of attributes. In total, 38 equivalence classes were present in the remaining 115 items. For each of the equivalence classes, a prototypical item was chosen by the researcher to be kept in the refined clinical context. A further 75 items were removed by this procedure, with the final set

of items maintained in the clinical context amounting to 39 items. For instance, ASI-3 items *i31* ("When I cannot keep my mind on a task, I worry that I might be going crazy") and *i34* ("It scares me when I am unable to keep my mind on a task") investigate the same set of attributes through different items (i.e., meta-worry and lack of concentration). In this case, item *i34* was deemed the most prototypical item from the equivalence classes to be kept in the final clinical context. This was done since the term "crazy" present in item *i31* has a deeper linguistic connotation than that of fear stemming from perceived diminished cognitive capacity present in item *i34*. Furthermore, it is important to note that in one case, two items were necessary for assessing one of the equivalence classes (items *i60* and *i106* both investigate *a19*). This was admissible as none of the initial items clearly assessed all the symptoms of autonomic hyperarousal (attribute 19). In addition, other equivalence classes containing a relation with attribute 19 always mentioned a specific symptom of autonomic hyperarousal, making it imperative to not discard any of items *i60* or *i106*.

The attributes which were most present in the items taken from the various psychometric tests were meta-worry (26 items) and autonomic hyperarousal (24 items). Overall, each of the attributes chosen for this study was investigated by one or more items. However, it is interesting to note that only one item (HAM-A.4) directly investigated sleep disturbance (despite it being one of the criteria for diagnosing GAD as per the DSM-5-TR and the ICD-11). Furthermore, only two items directly investigated the attribute of abstract/multifocal worry. This study suggests that this attribute was assessed indirectly by the chosen psychometric tests as they were each composed by various items assessing different worries. The best example for this was the WDQ-SF, which assesses various worry domains, making multifocal worry a prerequisite for anyone who affirms holding multiple worry domains. Table 4.5 presents the complete list of the number of times each attribute was investigated by an item.

Table 4.5: Total number of initial items investigating each attribute

Attributes	a1	a2	a3	a4	a5	a6	a7	a8	a9	a10	a11	a12	a13	a14	a15	a16	a17	a18	a19
Initial clinical context	16	7	2	26	6	13	5	12	6	4	10	6	5	1	6	4	8	19	24
Refined clinical context	4	2	2	9	2	6	1	7	5	3	3	5	2	1	2	2	2	5	6

4.3.2 Ad hoc items recommended by this study

The refined set of items making up the final clinical context presented a number of items for each distinct attribute. In most cases, besides having an item which only investigated a determined attribute, the clinical context also consisted of at least another item investigating the same attribute in conjunction with another attribute. A critical factor for the development of prerequisite relations between items is for each of the chosen attributes to possesses an item in the clinical context which analyses the attribute it is in relation with without also investigating secondary attributes. Thus, each attribute should have an item it is in relation with individually in order to more accurately predict future responses to items investigating two attributes simultaneously. Hence, it was imperative to create three *ad hoc* items which could investigate attributes *a5*, *a9*, *a13* without also investigating secondary attributes as no items present in the refined clinical context had an independent relation to each of these three attributes. The *ad hoc* items which this study recommended adding to the refined clinical context are:

1. Avoidance (*a5*): "I feel less afraid about something if I can worry about it"

2. Emotional dysregulation (*a9*): "When I am feeling anxious, I rarely manage to be in control of my emotions"

3. Persistence of worry in daily living (*a13*): "I have been worrying for quite some time now"

Chapter 5: Discussion

5.1   Placing the refined clinical context for GAD within the current literature

Through the application of FPA methodology, this study identified the equivalence classes relevant for the investigation of GAD symptoms present in eight different psychometric tests used for this purpose. This study developed the attributes of GAD and analysed their occurrence in common psychometric tests used, amongst other things, for the diagnosis of GAD. The result of this work was the grouping of the psychometric tools' items relevant for the investigation of GAD attributes in the form of a Boolean matrix (presented in Table 4.4). This provided the possibility to trace back each item to the aspects of GAD which it investigates, making it possible to reduce the number of items needed, whilst also adding three more items necessary for obtaining a complete set of equivalence classes.

This study proposes that, once the clinical structure is validated, it may be applied to computerised adaptive testings (CATs) which would maintain the benefits of short-form questionnaires whilst still being adaptive in nature (such as clinical semi-structured interviews; see Chapter 3). This approach has already been applied in the past and is rapidly forming a vast array of FPA methods for various psychological disorders. Such studies contribute to the Adaptive Testing System for Psychological Disorders (ATS-PD) and have been applied to obsessive compulsive disorder (Donadello et al., 2017), major depressive episodes (Serra et al., 2015; Spoto et al., 2018), and recently, even to a behaviour driven observation of nonverbal behaviours of schizophrenia (Granziol et al., 2020).

Serra et al. (2015) identified various strengths for the application of FPA to self-report questionnaires assessing major depressive episodes which also apply to this study. Namely, understanding and pin-pointing the pre-existing relationships between items and attributes allows for eliminating redundant items which investigate the same set of attributes using different, yet similar wording. This not only automatically increases the efficiency of the

psychometric tool, but it also makes it easier to define an individualised portrayal of the individual's scores. In this way, completion of the questionnaire would not simply provide a score, but a network of attributes which the individual automatically endorsed by affirming a set of items. Each individual completing such a questionnaire would thereof provide the clinician with an individualised set of symptoms which s/he is disturbed by. Thus, the clinician would be obtaining a clear portrayal of a client's clinical state without having to rely on more costly and time-consuming practices. Such a tool would function similarly to a semi-structured interview, in that each response would lead to a different question on basis of the probability that the individual would endorse the subsequent item. This study, like others before it, proposes that the implementation of a clinical context in this setting could be a useful tool for the treatment of psychological disorders.

5.2 Limitations

Having yet not been tested and validated, this study aspires to be a starting point for future development of an adaptive tool for assessing GAD. The main limitation for this study revolves around the creation of the clinical context. Having no preordained method for obtaining the attributes for GAD, the construction of the clinical context depended on the careful investigation of the researcher. Such a procedure is bound to be subject to a degree of personal bias, which should have been mitigated by the study's reliance on previous literature surrounding GAD. In any case, the FPA methodology allows for a great degree of flexibility as items can easily be updated as newer research is conducted whilst keeping the clinical structure relatively intact (Serra et al., 2015).

5.3 Future applications

The flexibility of this methodology also accounts for the time-consuming nature of its application. Generally speaking, the construction of a clinical context for a psychological disorder is a long and subjective process which is subject to human error. Furthermore, in order

to unlock the full potential of FPA methodology, research on the application of FPA to different psychological disorders is needed. This could eventually lead to wider networks of adaptive questionnaires which interconnect between different psychological disorders. This study recognises itself to be a relatively small, although important contribution to the construction of a wider clinical context for anxiety disorders. We hope that such advancements would eventually be able to aid the diagnosis of comorbidities and differential diagnoses.

Chapter 6: Conclusion

6.1   Future applications: Studying comorbidities

The research aim of this study was to review the literature pertaining to GAD in order to create a set of attributes for this theoretical construct. As per FPA methodology, this was to be then applied to a clinical context for GAD by examining current, pre-existing psychometric tools for GAD. Additional equivalence classes were to be added where needed to the ones present in the refined version of the clinical context for obtaining a complete set of items; efficient for its lack of redundant items and elaborate for its level of depth beyond surface level scores which were otherwise the only result obtained from the assessed psychometric tools. This study demonstrated that none of the chosen psychometric tools investigated all the attributes of GAD. Through the applied FPA methodology, the refined clinical context may now investigate all the attributes with only 42 items (39 items from the clinical context and 3 additional *ad hoc* items).

This clinical context, once validated within the FPA framework, can be used as a stand-alone tool to assist the clinician in the diagnostic process of GAD. This study proposes that its full potential is found in its flexibility and adaptability, which would allow it to be linked to a network of clinical contexts which have already been created through FPA methodology. Donadello et al. (2017) asserted that the application of FPA to other psychological disorders is a necessary step for the enrichment of the ATS-PD which could be developed into an adaptive software product which makes use of prerequisite relations and probabilistic models such as the basic local independence model (BLIM).

In particular, this study suggests that the clinical context obtained through this study could be conjoined to the work of Serra et al. (2015) on the application of FPA to major depressive disorder (MDD). This could be a useful tool for the clinician given that almost half of patients with lifetime MDD also had a lifetime diagnosis of an anxiety disorder, highlighting

the comorbid nature of anxiety disorders and MDD (Kessler et al., 2015). It is worth noting that the clinical context of GAD proposed by this study already shares three common attributes with the aforementioned clinical context for MDD (i.e., irritability, sleep disturbances, and lack of concentration). In future research, such contexts could easily be integrated into an adaptive tool for assessing not only the separate disorders, but also the comorbidity between the two psychological disorders.

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Appendix A: Original Domain of the Clinical Context

ID	a1	a2	a3	a4	a5	a6	a7	a8	a9	a10	a11	a12	a13	a14	a15	a16	a17	a18	a19	Total
i1	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	1	0	3
i2	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1
i3	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
i4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
i5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	2
i6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1
i7	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1
i8	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
i9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
i10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
i11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
i12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
i13	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
i14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	2
i15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
i16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
i17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
i18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
i19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
i20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
i21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	2
i22	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
i23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	2
i24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
i25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
i26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
i27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
i28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
i29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
i30	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
i31	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	2
i32	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2
i33	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2
i34	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	2
i35	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2
i36	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2
i37	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2
i38	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
i39	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	2
i40	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1

i41	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
i42	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
i43	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	2
i44	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	2
i45	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	2
i46	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
i47	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	2
i48	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	2
i49	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	2
i50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
i51	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
i52	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1
i53	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
i54	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	2
i55	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
i56	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
i57	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
i58	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
i59	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
i60	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
i61	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	2
i62	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	2
i63	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	2
i64	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
i65	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	2
i66	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	2
i67	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
i68	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	2
i69	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
i70	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
i71	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
i72	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
i73	0	0	0	1	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	3
i74	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
i75	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1
i76	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	2
i77	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
i78	1	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	3
i79	1	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	3
i80	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	2
i81	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
i82	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1
i83	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1

i84	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
i85	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	2
i86	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	2
i87	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
i88	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	2
i89	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
i90	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
i91	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
i92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
i93	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	1	0	0	0	3
i94	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	2
i95	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
i96	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
i97	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
i98	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	2
i99	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
i100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
i101	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1
i102	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	2
i103	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
i104	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
i105	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1
i106	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
i107	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	2
i108	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
i109	0	0	0	0	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	3
i110	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	2
i111	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
i112	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	3
i113	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	2
i114	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	2
i115	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	2
i116	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
i117	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1
i118	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	2
i119	1	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	3
i120	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
i121	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
i122	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
i123	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
i124	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	2
i125	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
i126	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1

																				Total
i127	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	2
i128	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	2
i129	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1
i130	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1
i131	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	2
i132	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
i133	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
i134	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
i135	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	2
i136	0	0	0	0	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	3
i137	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
i138	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	2
Total	16	7	2	26	6	13	5	12	6	4	10	6	5	1	6	4	8	19	24	

N.B. Psychometric tools were added in the order presented below and items were kept in the same order of their respective sources.

1. GAD-7 (Spitzer et al., 2006): *i1* to *i8*

2. BAI (Beck et al., 1988): *i9* to *i29*

3. ASI-3 (Taylor et al., 2007): *i30* to *i47*

4. HAM-A (Hamilton, 1959): *i48* to *i61*

5. WDQ-SF (Stöber & Joormann, 2001): *i62* to *i71*

6. PSWQ (Meyer et al., 1990): *i72* to *i87*

7. DASS-21 (Lovibond & Lovibond, 1995): *i88* to *i108*

8. MCQ-30 (Wells & Cartwright-Hatton, 2004): *i109* to *i138*