Chapter 2
Measuring Anhedonia in Schizophrenia-Spectrum Disorders: A Selective Update

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Abstract The main objective of this chapter was to carry out a selective review of the main measuring instruments used for the assessment of anhedonia and hedonic capacity. First, we briefly discuss the historical origins of the concept of anhedonia. Given that one's conceptualization of a given latent construct guides the development and/or selection of measurement instruments, we consider various conceptualizations and operational definitions of anhedonia and hedonic capacity. While doing this, we briefly discuss the hypothesized special relationship that is thought to exist between anhedonia and schizotypy, the latent construct underlying a diathesis for schizophrenia-spectrum disorders. Following this, we present some clinical interviews and self-report instruments used in the assessment of anhedonia. Some of the instruments are stand-alone measures of anhedonia and/or hedonic capacity (as an indirect measure of anhedonia), while other assays of anhedonia are obtained within the context of a more general assessment of negative symptoms. We have chosen to focus only on those interviews and self-report measures that are either new or of special relevance to research and clinical assessment of schizotypy, schizophrenia,

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and schizophrenia-spectrum disorders. For each of the measures reviewed, the main psychometric properties are described. Finally, some limitations are discussed and suggestions for future research directions are offered.

Keywords Anhedonia • Negative symptoms • Schizotypy • Assessment • Clinical interviewing • Self-report • Questionnaires

Abbreviations

ACIPS	Anticipatory and Consummatory Interpersonal Pleasure Scale
BIS/BAS	Behavioral Inhibition and Behavioral Activation Scales
BNSS	Brief Negative Symptom Scale
BPRS	Brief Psychiatric Rating Scale
CAINS	Clinical Assessment Interview for Negative Symptoms
CAPE-42	Community Assessment Psychic Experiences-42
CAT	Computerized Adaptive Testing
CTT	Classical Test Theory
ESQUIZO-Q	Oviedo Questionnaire for Schizotypy Assessment
ICC	Intra-Class Correlation
IRT	Item Response Theory
MAP-SR	Motivation and Pleasure Scale-Self-report
MATRICS	Measurement and Treatment Research to Improve Cognition in Schizophrenia
MMPI	Minnesota Multiphasic Personality Inventory
NIMH	National Institute of Mental Health
O-LIFE (B)	Oxford-Liverpool Inventory of Feeling and Experiences (Brief)
PANSS	Positive and Negative Syndrome Scale
PAS	revised Physical Anhedonia Scale
PAS-B	revised Physical Anhedonia Scale-Brief
RDoC	Research Domain Criteria
RSAS	revised Social Anhedonia Scale
RSAS-B	revised Social Anhedonia Scale-Brief
SANS	Scale for Assessment of Negative Symptoms
SD	Standard Deviation
SOPS	Scale of Prodromal Symptoms
SPQ-B	Schizotypal Personality Questionnaire-Brief
SPQ-BR	Schizotypal Personality Questionnaire-Brief Revised
TEPS	Temporal Experience of Pleasure Scale
TEPS-ANT	Anticipatory subscale of the TEPS
TEPS-CON	Consummatory subscale of the TEPS
TPSQ	Thinking and Perceptual Style Questionnaire
VMPFC	Ventromedial Prefrontal Cortex
WCST	Wisconsin Card Sorting Test

2.1 Introduction

Schizophrenia is a serious and devastating mental disorder characterized by symptoms such as hallucinatory experiences, delusional ideation, negative symptoms, and disorganized speech and behavior, which usually has its onset during late adolescence or early adulthood [1–3]. Epidemiological data indicates that the median lifetime prevalence estimated for schizophrenia is 4.0 per 1,000 persons [4]. Schizophrenia and schizophrenia-spectrum disorders have a direct impact on the lives of individuals at the personal, educational, family and occupational levels. In fact, psychotic symptoms do not only have immense repercussions on the health and quality of life of patients, but also on health care costs and society [5, 6]. For example, patients with schizophrenia die approximately 12–15 years earlier than the average individual in the general population [7]. The main reason for this mortality increase, in addition to suicide, is related to physical causes and the increase in the frequency of risk factors such as the lack of physical activity, obesity, diabetes, and tobacco addiction [7–9].

Despite considerable advances in the management and treatment of schizophrenia and schizophrenia-spectrum disorders, negative symptoms have remained largely treatment-refractory. Indeed, for many individuals affected by schizophrenia, the negative symptoms, namely, restricted affect, emotional expression, poverty of speech, anhedonia, asociality and diminished motivation and sense of purpose, appear to be the rate-limiting steps in terms of quality of life and their achieving optimal functional outcomes (e.g., integration into the community and workplace). As such these negative symptoms have emerged as a treatment target in their own right, distinct from positive symptoms. Recently, anhedonia has been identified as an important factor that contributes to the health-related quality-of-life deficit observed in individuals with schizophrenia and schizoaffective disorder [10]. Anhedonia is the focus of considerable clinical research, though to date, there have not been any pharmacological and/or psychosocial breakthroughs.

The main objective of this chapter was to carry out a selective review of the main measuring instruments used for the assessment of anhedonia and hedonic capacity. This chapter deals with the assessment of anhedonia and hedonic capacity in individuals at risk for and/or affected by schizophrenia and schizophrenia spectrum disorders. First, we briefly discuss the historical origins of the concept of anhedonia. Given that one's conceptualization of a given latent construct guides the development and/or selection of measurement instruments, we consider various conceptualizations and operational definitions of anhedonia and hedonic capacity. While doing this, we briefly discuss the hypothesized special relationship that is thought to exist between anhedonia and schizotypy, the latent construct underlying a diathesis for schizophrenia-spectrum disorders [11]. Following this, we present some clinical interviews and self-report instruments used in the assessment of anhedonia. Some of the instruments are stand-alone measures of anhedonia and/or hedonic capacity (as an indirect measure of anhedonia), while other assays of anhedonia are obtained within the context of a more general assessment of negative symptoms. We have chosen to focus only on those interviews and self-report measures that are either

new or of special relevance to research and clinical assessment of schizotypy, schizophrenia, and schizophrenia-spectrum disorders. For each of the measures reviewed, the main psychometric properties are described. Finally, some limitations are discussed and suggestions for future research directions are offered.

2.2 The Construct of Anhedonia

2.2.1 The Origins of the Construct

The origins of the term "anhedonia" can be traced back to Ribot, a psychoanalytic psychologist [12, 13]. However, most clinicians associate the term with the writings of Rado [14, 15] and Meehl [11]. The literal translation of the word "anhedonia" is "without pleasure". However, because few people truly experience a complete lack of pleasure across all contexts, the term is typically used to denote a diminution or reduction in the capacity to experience pleasure. Interestingly, there seems to be a discrepancy in the way that some (predominantly depression) researchers operationally define anhedonia compared to other (predominantly schizophrenia) researchers. Some define anhedonia as a "decrease in the capacity to experience pleasure *from previously pleasurable activities*" (p. 123) [13]; there is an inherent state-like quality in that conceptualization. In keeping with Meehl [16], however many schizophrenia researchers regard schizotypy as a diminished ability to derive pleasure from typically pleasurable sources/stimuli. Note that the latter conceptualization does not assume that the individual ever found these stimuli pleasurable or had experience with them. These subtle distinctions in the operational definitions of anhedonia are noteworthy, in part because one's assessment of a construct is guided by one's conceptualization of the construct.

2.2.2 Operational Definitions of Anhedonia

Pleasure is, by definition, a multi-faceted trait, characterized by positive affect, anticipation of an experience that will evoke pleasure, recall of past satisfying experience, and willingness/motivation to increasingly exert effort to achieve such an experience in the future [17]. Anhedonia, the reduced capacity to experience pleasure, may be described in terms of the hedonic domains that are affected, such as the physical domain versus the social domain. Thus, we talk about the characteristics of individuals who experience physical anhedonia and those who experience social anhedonia.

The dimininuition of pleasurable experience may also be described in terms of the chronology of the affective experience. Animal, clinical, and affective neuroscience research suggest that approach-related, appetitive pleasure is distinct from consummatory pleasure [18]. Anticipatory pleasure states are more closely related

to the experience of "wanting", whereas consummatory states are more closely related to the "in the moment" experience of satiety [19]. In this regard, we might talk about the characteristics of patients who display anticipatory pleasure deficits, and question whether they also have consummatory pleasure deficits. Thus far, considerably more research has been conducted studying social and physical anhedonia. However there are several factors that render it likely for there to be a substantial increase in research examining the distinction between anticipatory and consummatory pleasure in both nonpatient and patient populations. First, there is evidence that the different components of pleasure have at least partially dissociable neural circuitry [20–22]. Secondly, in 2005, a NIMH-sponsored group [23] embraced the idea of incorporating the distinction between appetitive and experienced components of pleasure in the assessment of negative symptoms.

2.2.3 The Prevalence of Anhedonia

If one considers hedonic capacity as a trait characteristic that is normally distributed throughout the population, then it is possible to account for the presence of anhedonia, albeit at low base rates, in the general population. Furthermore, if one conceptualizes hedonic capacity as being bimodal, i.e., the normally hedonic group falling in one distribution and the anhedonic in the second, smaller distribution, then, again, the base rates would seem appropriate. In this way, anhedonia might best be considered on a continuum, rather than categorically [24].

Anhedonia has been observed in patients with various psychiatric disorders including mood disorders, particularly major depressive disorder [13, 22, 25], substance use disorders [26, 27], and drug-induced psychosis [28]. Indeed, there are reports of anhedonia in autism [29], eating disorders [30], and post-traumatic stress disorder [31]. There are also reports of anhedonia accompanying various other medical disorders, such as Parkinson's disease [32], coronary artery disease [33], and diabetes [34]. Although anhedonia is a prominent symptom in depression, a comparative study by Blanchard, Horan, and Brown [25] indicated that anhedonia is state-related in major depressive disorder, though trait-related in schizophrenia. A 10-year follow-up study by Herbener and Harrow [35] also indicated that anhedonia is a stable clinical feature of schizophrenia.

2.2.4 Issues of Specificity: The Special Relationship Between Anhedonia and Schizotypy

Several clinicians and theoreticians have posited a special relationship between anhedonia and schizotypy, the hypothesized latent trait underlying risk for schizophrenia and schizophrenia-spectrum disorders. Since the early writings of Rado [14, 15] and Meehl [11], anhedonia has been hypothesized as either a contributing or

potentiating factor in the development of schizophrenia-spectrum [11, 16, 36]. However, studies indicate that anhedonia is not present in all patients with schizophrenia and schizophrenia-spectrum disorders. Estimates vary, but up to 80 % of schizophrenia patients show at least moderate levels of anhedonia [37]. In summary, anhedonia is a common, stable trait-like condition for a substantial portion of the schizophrenia-spectrum and it is currently treatment-refractory.

2.3 The Assessment of Anhedonia

Anhedonia has been prominent in clinical descriptions of schizophrenia since Kraepelin [38] and Bleuler [39], Recently, however, there has been a resurgence of interest in assessing and describing it [40]. A 2005 meeting, sponsored by the NIMH [23], provided some of the impetus for the development of several of the measures described below.[1]

2.3.1 Clinical Assessment

There are several tools for the assessment of anhedonia and negative symptoms [41] in psychosis: the Scale for the Assessment of Negative Symptoms [42], Positive and Negative Syndrome Scale [43], Clinical Assessment Interview for Negative Symptoms [44] and Brief Negative Symptom Scale [45]. Also, there are structured interviews such as the Scale of Prodromal Symptoms [46] for the assessment at high risk mental states in help-seeking samples. After reviewing the SANS, we provide an in-depth analysis of the new developments in the assessment of negative symptoms, according to the NIMH negative symptoms consensus [23].

2.3.1.1 The Scale for the Assessment of Negative Symptoms (SANS)

The SANS [42] is an interview-based instrument designed to assess negative symptoms in schizophrenia and its related disorders. It consists of 25 items, which fall into five a priori symptom domains, namely, affective flattening, alogia, avolition-apathy, anhedonia-asociality and attention. The items are rated on a 6-point Likert scale (0 = *absent/not at all*; 5 = *severe/extreme*). For each of the subscales, there is a global subscale score as well. The SANS Anhedonia-Asociality subscale consists of 4 items that cover recreational interests and activities, sexual interest and activities, ability to feel intimacy and closeness, and relationships with friends and peers. In this way, anhedonia is operationally defined as encompassing a reduced ability to experience pleasure when participating in pleasurable activities

[1] Neither of the authors of this chapter were attendees of the NIMH-sponsored meeting.

as well as social withdrawal and lack of involvement in social relationships. The SANS includes queries regarding the frequency of the respondent's social engagement, as well as their interest in and enjoyment of their activities.

There have been other relatively recent discussions of the psychometric properties of the SANS (for a review see [40, 47]). There are relatively few published reports of systematic studies regarding the psychometric characteristics of the Anhedonia-Asociality subscale of the SANS [40]. Briefly, the reliability scores range between 0.63 and 0.83 and test-retest reliability ranging from 0.25 to 0.37. Also, the findings indicate good levels of rater agreement ranges from 0.75 to 0.92 (for total score). Factor analysis indicates that the SANS measures two fairly independent dimensions of schizophrenic symptomatology (diminished expression and combined anhedonia-asociality) [40, 44, 45, 47–50].

There have been some criticisms of the SANS. There is some concern that the Anhedonia-Asociality subscale may confound patients' hedonic capacity with other aspects of social functioning, such as level of interest and engagement in recreational and social activities. While all of this information is useful clinically, it would be helpful to differentiate the information in terms of targeting different aspects for appropriate types of intervention (e.g. pharmacological, vocational, social skills training, etc.). Due to its length, several researchers suggest that the SANS be shortened. For example, Levine and Leucht [50] tested the psychometric properties of the short research version of the SANS in a sample of 487 patients with schizophrenia. The results shown that the short version of the SANS is adequate to assess predominantly negative symptoms in chronic schizophrenia in research settings.

Despite its limitations, the SANS is one of the interviews recommended for use by the NIMH-MATRICS workgroup on negative symptoms [23]. An advantage of this measure is that there is a global score per each domain, so overall global/summary scores can be derived. Suggested interview questions and prompts are built into this measure, and it also contains explicit anchor points. Not surprisingly, the SANS has been translated into numerous foreign languages. At present, the SANS is considered to be the standard interview-based assessment that all other similar measures of negative symptoms are compared with. Indeed, the SANS is perhaps the most well-known interview-based measure for the assessment of negative symptoms in general, and especially, anhedonia.

2.3.1.2 The Clinical Assessment Interview for Negative Symptoms (CAINS)

The CAINS [44, 51] is an interview-based measure for the assessment of negative symptoms. The CAINS was purportedly designed to address limitations of extant measures, incorporate knowledge from affective neuroscience, and provide more comprehensive coverage of negative symptoms. For example, this semi-structured interview includes extensive prompts and follow-up questions for each item, as well as anchors, in order to guide interviewers in the administration and scoring of the measure. The CAINS items are scored on a 7-point Likert scale with higher scores

reflecting greater pathology. The CAINS distinguishes between the categorical (i.e., social, physical, and recreational/vocational) and temporal (experienced versus expected) aspects of pleasure. The CAINS also distinguishes between social anhedonia and asociality, operationally defined as the preference for being alone and low or lack of value placed on relationships. Out of 23 items, 9 items comprise an anhedonia subscale and 3 items comprise an asociality subscale.

Limited data indicated evidence of convergent validity for the CAINS-beta. The CAINS-beta anhedonia subscale correlated negatively with the TEPS-ANT and TEPS-CON, and positively with the SANS asociality subscale. However, the CAINS-beta anhedonia subscale failed to correlate significantly with the SANS anhedonia subscale. Internal consistency for the CAINS-beta anhedonia subscale was adequate (0.74). The developers of the interview acknowledged the difficulty of setting pathological thresholds for the anhedonia items assessing the frequency and intensity of pleasurable events in the absence of normative data.

Subsequent development of the CAINS was conducted, using the largest standardization sample of any scale developed for the assessment of symptoms in schizophrenia [44, 52]. The final 13-item version was empirically derived from the CAINS-beta using both CTT and IRT [51, 53]. Results from structural analyses yielded two general factors: expression (four items reflecting diminished outward expression and speech) and motivation pleasure. Across the four testing sites, the internal consistency for the CAINS ranged from 0.74 to 0.88. In terms of the motivation/pleasure and expression subscales, inter-rater agreement (0.93 and 0.77, respectively) and test-retest reliability (0.69 and 0.69) was good overall. The developers reported evidence of convergent validity for the CAINS. Ratings on the CAINS Motivation/Pleasure subscale correlated with the BPRS negative symptoms subscore, SANS asociality/anhedonia subscore, and the RSAS. The CAINS Motivation/Pleasure subscale ratings also correlated negatively with TEPS-ANT and TEPS-CON scores.

An accompanying training manual and videos are available to facilitate use of the CAINS. To date, the CAINS has been translated into Chinese and French, thereby allowing it to be used internationally. Thus far, the CAINS has only been administered to outpatients with schizophrenia or schizoaffective-disorder. It is unclear how amenable this measure is to its use in inpatient settings. Moreover, the instrument is quite lengthy, which may limit its usefulness in certain contexts, such as genetic studies, early intervention studies, and general psychiatric practice.

2.3.1.3 The Brief Negative Symptom Scale (BNSS)

The BNSS [45] is another interview-based measure for the assessment of negative symptoms. Like the CAINS, the BNSS was developed in response to a perceived need, following a NIMH Consensus Development Conference on Negative Symptoms held in 2005, to improve upon the assessment of negative symptom domains for use in clinical as well as research settings. The BNSS is a 13-item semistructured interview organized into 6 subscales, namely, Anhedonia, Distress, Asociality,

Avolition, blunted affect, and Alogia. All items in the BNSS are rated on a 7-point Likert scale, generally ranging from the absence of a symptom (0) to a symptom appearing severe (6). The BNSS anhedonia subscale consists of three items which assess the intensity of pleasure during activities, frequency of pleasure during activities, as well as the intensity of expected pleasure from future activities. In addition, there are two asociality items, measuring behaviour and inner experience, which may be related to social anhedonia.

The BNSS has good psychometric characteristics [45, 54, 55]. The internal consistency for the total scores ranges from 0.93 to 0.95. In schizophrenia and schizoaffective patients, the BNSS displays high temporal stability, with the total BNSS test-retest reliability being estimated at 0.81 and the subscales also showing good test-retest reliability, ranging from 0.76 to 0.90 (anhedonia r = 0.76). Also, the findings indicate good levels of rater agreement ranging from 0.77 to 0.95 (anhedonia ICC = 0.95). Principal axis extraction indicated two distinct components, namely, an Amotivation and Pleasure dimension, consisting of the items in the anhedonia, avolition, and asociality subscales, and an Emotional Expressivity dimension, consisting of the blunted affect, alogia, and lack of normal distress subscale [54]. Together, these two factors accounted for nearly 69 % of the variance.

Results indicated that the BNSS has good convergent and discriminant validity in its relationships with other symptom rating scales, functional outcome, self-reported anhedonia, and functional outcome. For example, it is encouraging that the BNSS Anhedonia subscale total score and SANS Anhedonia/Asociality subscale scores were positively and moderately highly correlated, as were the BNSS and SANS Anhedonia/Asociality scores [45]. Moreover, the BNSS anhedonia subscale was significantly correlated with the RSAS and PAS. Interestingly, both the BNSS Intensity of Pleasure and Frequency of Pleasure items were significantly correlated with both the RSAS and PAS. However, the Intensity of Future Pleasure item was only correlated with social anhedonia, as measured by the RSAS, not physical anhedonia, as measured by the PAS [45, 54, 55].

There are several advantages to this new interview-based measure. First, the BNSS is designed so that a clinician or researcher can administer the BNSS in approximately 15 min. The brevity of this measure contrasts with the SANS (typically requires 25–30 min) and the CAINS (estimated time required 45 min). A second advantage of the BNSS is its strong psychometric characteristics. For example, the BNSS has demonstrated good separation of its two-factor structure, namely motivation-pleasure and emotional expressivity; this has proven more difficult for the CAINS [53]. Although the instrument was designed primarily for use in treatment trials, due to its high test-retest reliability, it can also be used in clinical evaluations, to track clinical change.

It appears to be applicable to both inpatient and outpatient clinical use, though to date, it has only been piloted on outpatient schizophrenia-spectrum patients. The BNSS is accompanied by a training manual and workbook including suggested questions and scoring anchors in order to guide users of the instrument. In conclusion, the BNSS can be considered a promising new instrument for use in clinical trials.

Table 2.1 Measurement instruments for the assessment of anhedonia or hedonic capacity

Name	Main reference(s)	Abbreviation	N° items	Format
Scale for the assessment of Negative Symptoms	[42]	SANS	25	Likert 6
Positive and Negative Syndrome Scale	[43]	PANSS	30	Likert 7
Clinical Assessment Interview for Negative Symptoms	[44]	CAINS	13	Likert 7
Brief Negative Symptom Scale	[45]	BNSS	13	Likert 7
Motivation and Pleasure Scale-Self-report	[56, 57]	MAP-SR	15	Likert 5
Scale of Prodromal Symptoms	[46]	SOPS	19	Likert 7
Revised Physical Anhedonia Scale	[17]	PAS	61	True/False
Revised Physical Anhedonia Scale-Brief	[62]	PAS-B	15	True/False
Revised Social Anhedonia Scale	[58]	RSAS	40	True/False
Revised Social Anhedonia Scale-Brief	[62]	RSAS-B	15	True/False
Schizotypal Personality Questionnaire (Brief)	[59, 63]	SPQ (B)	74/ 22	True/False
Oxford-Liverpool Inventory of Feeling and Experiences (Brief)	[64, 65]	O-LIFE (B)	159/43	Yes/No
Community Assessment Psychic Experiences –42	[66]	CAPE-42	42	Likert 4
Thinking and Perceptual Style Questionnaire	[67]	TPSQ	99	Likert 5
Oviedo Questionnaire for Schizotypy Assessment	[60]	ESQUIZO-Q	51	Likert 5
Temporal Experience of Pleasure Scale	[19]	TEPS	18	Likert 6
Anticipatory and Consummatory Interpersonal Pleasure Scale	[33, 61]	ACIPS	17	Likert 6

2.3.2 Self-report Assessment

Several self-report measures have been used to measure anhedonia in individuals at risk for or affected by schizophrenia-spectrum disorders. These measures include: the Motivation and Pleasure Scale-Self-report (MPS-SR) [56, 57], Revised Physical Anhedonia Scale (PAS) [17] and Revised Social Anhedonia Scale (RSAS) [58], Schizotypal Personality Questionnaire (SPQ) [59], Oviedo Questionnaire for Schizotypy Assessment (ESQUIZO-Q) [60], Temporal Experience of Pleasure Scale (TEPS) [19] and Anticipatory and Consummatory Interpersonal Pleasure Scale (ACIPS) [61]. Although other measures within the psychometric high-risk paradigm and early intervention research traditions have been developed (see Table 2.1), we do not discuss them here. In the sections that follow, we critically review the extant literature regarding each of the aforementioned scales; where applicable, their abbreviated versions are discussed as well. Table 2.2 shows psychometric properties for the measurement instruments and Table 2.3 provides examples of items included in each of the scales reviewed.

Table 2.2 Psychometric properties for the measurement instruments

Name	Reliability	Interrater	Test-retest	Sources of validity	References
SANS	0.63/0.82	0.75/0.92 (global)	0.28/0.37	Internal structure and related with other measures	[40, 44, 45, 47–50]
PANSS	0.83/0.90	0.72/0.89	0.68	Internal structure and related with other measures	[40, 43, 45, 47, 68–72]
CAINS	0.74/0.88	0.77/0.93	0.69	Internal structure and related with other measures	[44, 51, 53]
BNSS	0.93/0.95	0.96 (0.76 anhedonia)	0.76/0.90	Internal structure, predictive, and related with other measures	[45, 54, 55]
MAP-SR	0.90	–	–	Internal structure and related with other measures	[56, 57]
SOPS	0.87/0.93	0.74/0.91		Internal structure, predictive, ecological and related with other measures	[73–79]
PAS	0.77/0.92	–	0.65/0.84	Internal structure, predictive, ecological and related with other measures	[10, 19, 80–93]
PAS-B	0.62/0.91	–	–	Internal structure and related with other measures	[62, 91]
RSAS	0.75/0.95	–	0.75/0.84	Internal structure, predictive, ecological, and related with other measures	[10, 44, 62, 81–90, 92–99]
RSAS-B	0.75/0.92	–	–	Internal structure and related with other measures	[62, 91]
SPQ[a]	0.57/0.82	–	0.41/0.70	Internal structure, predictive and related with other measures	[100–107]
O-LIFE (Brief)[b]	0.42/0.87	–	0.72–0.85	Internal structure and related with other measures	[108–116]
CAPE-42	0.78/0.93	–	0.64 (negative)	Internal structure, predictive, and related with other measures	[66, 111, 117–123]
TPSQ[c]	0.75–0.85	–	0.65–0.79	Internal structure and related with other measures	[67, 124–127]
ESQUIZO-Q[d]	0.66/0.77	–	–	Internal structure and related with other measures	[60, 128, 129]
TEPS	0.63/0.87	–	0.75–0.81	Internal structure and related with other measures	[19, 44, 83, 130–137]
ACIPS	0.87	–	0.78	Internal structure and related with other measures	[34, 35, 138, 139]

Note:
[a]No close friends and constricted affect (Social Anhedonia)
[b]Introvertive anhedonia
[c]Physical and social anhedonia
[d]Anhedonia dimension

Table 2.3 Examples of self-report items for assessment of hedonic capacity and anhedonia

Self-reports	Items
Motivation and Pleasure Scale-Self-report	In the past week, what is the most pleasure you experienced from being with other people?
	In the past week how motivated have you been to be around other people and do things with them?
Physical Anhedonia Scale (Brief)	I have often found walks to be relaxing and enjoyable
	A brisk walk has sometimes made me feel good all over
Revised Social Anhedonia Scale (Brief)	Having close friends is not as important as many people say
	I never had really close friends in high school
Schizotypal Personality Questionnaire	I find It hard to be emotionally close to other people
	Do you feel that you cannot get "close" to people?
Oxford-Liverpool Inventory of Feeling and Experiences-reduced	Are you much too independent to get involved with other people?
	Do you love having your back mass?
Oviedo Questionnaire for Schizotypy Assessment	I like to meet again with friends I have not seen in a while
Temporal Experience of Pleasure Scale	A hot cup of coffee or tea on a cold morning is very satisfying for me
	When I hear about a new movie starring my favorite actor, I can't wait to see it
Anticipatory and Consummatory Interpersonal Pleasure Scale	I enjoy watching films about friendships or relationships with my friends

2.3.2.1 Motivation and Pleasure Scale-Self-report (MAP-SR)

The MAP-SR [56, 57] is an 18-item self-report version of the CAINS Motivation and Pleasure subscale designed to assess the severity of the negative symptoms. An earlier version of the MAP-SR, called the CAINS-Self Report (CAINS-SR) [56] contained 30 items divided between an Experiential (avolition, anhedonia, asociality) and an Expressive (affect, alogia) subscale. The CAINS-SR included 9 items assessing the intensity and frequency of experienced (consummatory) and expected (anticipatory) pleasure across social, physical, and recreational/work domains. It also included 6 items assessing asociality. Despite high internal consistency (Cronbach's alpha = 0.90) for the overall measure, low levels of internal consistency values for the Expression subscale (0.40) led the authors to remove this subscale from the self-report version.

The MAP-SR [57] is a 15-item self-report measure of negative symptoms, which are rated on a 5-point Likert scale. The MAP-SR differs from the CAINS-SR in that it focuses exclusively on self-reported deficits in motivation and pleasure. Six items in the MAPS-SR assess the subject's experience of pleasure in both the past week as well as their expectations of future pleasure, and three items assess the subject's feelings and motivations about close, caring relationships. The internal consistency

for the MAP-SR in the sample of schizophrenia and schizoaffective patients was excellent (Cronbach's alpha = 0.90). As expected, the MAP-SR demonstrated good convergent validity with clinician ratings of motivation and pleasure on the CAINS. The MAP-SR also showed good convergent validity with other relevant self-report measures tapping social anhedonia such as the RSAS and the University of California, San Diego, Performance-Based Skills Assessment-Brief Version rating of social engagement. The MAP-SR was not significantly correlated with depressive symptoms or with the Positive Symptom or Depression/Anxiety subscales of the Brief Psychiatric Rating Scale, thereby demonstrating discriminant validity as well.

Overall, the MAP-SR's convergent and discriminant validity and internal consistency values indicate that the MAP-SR shows promise as a self-report measure of the severity of negative symptoms in schizophrenia. According to its developers, the MAP-SR is intended largely as way to screen people with elevated negative symptoms. Like its predecessor, the CAINS-SR, its psychometric properties have been evaluated on outpatients with schizophrenia and schizoaffective disorder. Thus far, however, the MAP-SR has not been evaluated in terms of its sensitivity or specificity for the detection of individuals with anhedonia. In addition, questions about the temporal stability of the MAP-SR scores have not been addressed. Future investigations of the MAP-SR across other patient groups, and in other populations are a necessary next step in order to realize the full potential of this measure.

2.3.2.2 Revised Physical Anhedonia Scale (PAS)

The PAS [17, 140] is a self-report questionnaire consisting of 61 items in a true/false format which measures the inability to experience pleasure from pleasant physical stimuli such as touch, taste, sight, smell, movement, sex, and sound. The PAS has been administered widely to schizophrenia outpatients [37, 80, 141] and inpatients [142]. Patients with schizophrenia report high levels of physical anhedonia on this measure [80, 141, 143–145]. It is noteworthy that a substantial proportion of schizophrenia patients produce PAS scores which overlap with those of healthy controls, leading some to question whether trait anhedonia is associated with a schizophrenia subtype, i.e., deficit syndrome schizophrenia [146].

The PAS has also been administered to first degree-relatives of patients [147, 148]. Overall, biological relatives report elevated rates of physical anhedonia [145, 149–151]. Some research indicates that PAS scores can distinguish between schizophrenia probands and their first-degree relatives [152] as well as distinguish between non-psychotic relatives of schizophrenia probands and controls [145, 149]. In the Roscommon Family Study, physical anhedonia scores were typically higher in relatives of schizophrenia patients with severe anhedonic symptoms [153].

The PAS has also been administered to college- and community-derived nonclinical samples [81, 82]. In nonpatient samples, the internal consistency of the PAS ranges from 0.77 to 0.92, and its test-retest reliability ranges from 0.65 to 0.84 (see Table 2.2). In the first longitudinal study of psychosis-proneness in recent-onset schizophrenia [80], the internal consistency of the PAS was 0.67 in the

patient group. The investigators found supportive evidence that schizophrenia and schizophrenia-spectrum patients' physical anhedonia is a vulnerability marker, i.e., their levels of physical anhedonia remained elevated across time and across assessments. These findings are consistent with those of longitudinal studies of chronic schizophrenia probands, which also indicate the trait-like nature of physical anhedonia [35, 154–156].

Physical anhedonia, as measured by the PAS, appears to have a taxonic structure in American and German samples [157]. Support regarding the concurrent validity of the PAS comes from investigations of nonclinical individuals with aberrantly high scores (i.e., greater than or equal to 2 SDs beyond the same-sex control group mean) who performed in similar, albeit attenuated patterns, as schizophrenia patients. For example, individuals identified as anhedonic on the basis of the PAS display smooth pursuit impairments, antisaccade task deficits and nailfold plexus visibility [158–160]. Moreover, Soliman et al. [161] demonstrated that physically anhedonic individuals show increased stress-induced striatal dopamine release. The measurement of trait anhedonia has increasingly included advances in neuroscience. Harvey et al. [162] obtained structural and functional imaging data from community-derived controls in order to examine correlates of individual differences in anhedonia. Trait anhedonia was inversely related to anterior caudate volume. In terms of functional neural correlates, the investigators noted an association between VMPFC activation and trait anhedonia during the processing of pleasant information [162]. Similarly, Dowd and Barch [163] noted a significant negative correlation within the VMPFC region between activation to reward-predictive cues and individual differences in PAS scores.

2.3.2.3 Revised Social Anhedonia Scale (RSAS)

The Revised Social Anhedonia Scale [58] is a self-report questionnaire consisting of 40 items true/false format which measures schizoid indifference, associability, lack of social enjoyment, and indifference towards others. The RSAS has been administered to college- and community-derived nonpatients [164–168] as well as psychiatric patients. In terms of patient samples, the RSAS has been administered to schizophrenia outpatients [25, 83, 154, 169, 170], schizophrenia inpatients [171], mixed groups of personality-disordered patients [172], patients with drug-induced psychoses [28], and eating-disordered patients [30]. First-degree relatives of schizophrenia patients have been assessed using this measure as well [173]. As such, the psychometric properties of the RSAS have been studied extensively (see Table 2.2). Briefly, the internal consistency of the measure ranges from 0.75 to 0.89, and test-retest reliability estimates range from 0.75 to 0.84.

The RSAS has high sensitivity (92 %) and moderately high specificity (75 %) [174]. Research findings continue to indicate that individuals with schizophrenia and schizophrenia-spectrum disorders report significantly greater levels of social anhedonia than do nonpsychiatric comparison participants (see, for example [25, 37, 40, 175]). In schizophrenia patients, the RSAS is correlated significantly and positively with their SANS total scores as well as their SANS 'anhedonia-asociality'

subscale scores. This elevation in social anhedonia is relatively independent of psychotic and depressive symptoms [25]. Moreover, in direct comparisons, individuals with schizophrenia report higher amounts of social anhedonia than individuals with schizophrenia-spectrum personality disorders [175]. Schizophrenia probands report significantly higher levels of social anhedonia than their siblings with nonpsychotic disorders and siblings without nonpsychotic disorders [152]. First-degree relatives of individuals with schizophrenia have reported significantly higher levels of social anhedonia compared to controls (Kendler et al. [176]).

Further supportive evidence regarding the concurrent validity of the RSAS can be derived from investigations of nonclinical individuals with aberrantly high scores (i.e., greater than or equal to 2 SDs beyond the same-sex control group mean) who performed in the deviant direction and in similar, albeit attenuated patterns, as schizophrenia patients. Individuals identified as socially anhedonic on the basis of the RSAS display subtle working memory, WCST, sustained attention and visuoconstructive impairments; aberrant perceptual biases; smooth pursuit impairments and antisaccade task deficits and nailfold plexus visibility [159, 160, 177–182]. To date, the RSAS is one of the sole self-report anhedonia measures that have been longitudinally validated as having predictive validity for the later development of schizophrenia and schizophrenia-spectrum disorders [94, 167, 183]. Secondary analysis of the Chapmans' 10-year follow-up data [94] as well as an independent replication using a different sample from a younger cohort longitudinally followed over 5 years [167, 183] indicate that the RSAS identifies individuals at specific risk for the development of schizophrenia-spectrum disorders.

The RSAS is a rather complex measure, which assesses more than solely social anhedonia. As Reise, Horan, and Blanchard [95] demonstrated, the latent structure of RSAS data is challenging to model due to the multidimensionality of the items (i.e., the degree of introversion, schizoid indifference, and lack of close relationships are measured in addition to the experience of interpersonal pleasure) as well as the cross-loadings among some of the items. Asociality, on the other hand, seems to have a taxonic nature [184].

In summary, the data suggest that the two Chapman anhedonia scales have construct, predictive, and concurrent validity. It is therefore not surprising that both the PAS and the RSAS are two of the most widely used measures for the assessment of anhedonia. They have been translated into several languages, including French, Spanish, Chinese, and German [185]. It is also noteworthy that items from both the PAS and RSAS were used to develop other measures used for more comprehensive schizotypy assessment (e.g., the O-LIFE and the TPSQ).

Nonetheless, there are some limitations to these oft-used measures. The items in these anhedonia scales may be criticized for being somewhat obviously focused on psychopathology, rendering some individuals defensive about their replies [186]. Some investigators [40, 187] have opined that the content validity of the PAS and RSAS may be outdated. Others have criticized the PAS and RSAS due to their relatively lengthy nature. Despite these criticisms of the full Chapman anhedonia scales, they continue to be the metric against which nearly all other putative measures of anhedonia are compared. Indeed, they are consistently included when evaluating the construct validity of other instruments related to hedonic capacity.

There have been at least a few attempts to create shortened versions of the anhedonia scales, particularly for the purposes of large-scale screening and inclusion in genetic research. Under the guidance of the Chapmans, Kendler et al. [176] reduced the RSAS to 16 items for use in their Roscommon Family Study. Hay and colleagues reduced [186] the full Chapman psychosis-proneness questionnaires to a 12-item questionnaire which included two items each from the PAS and RSAS. Their abbreviated survey suggested that highly selective culling of questionnaire items may result in a scale that resembles the basic factor structure observed in the original measures. Using CTT and an IRT framework, Kwapil and colleagues have created abbreviated forms of both Chapman anhedonia scales [188]. Both of the abbreviated scales consist of 15 items each. Thus far, the preliminary psychometric data look promising, though they are based solely on college undergraduates primarily from one lab (see Table 2.2). Nonetheless, a key question is the extent to which these abbreviated scales can still identify psychometrically at-risk individuals to the same extent, i.e., with the same predictive validity, as the full-length questionnaires.

2.3.2.4 The Schizotypal Personality Questionnaire (SPQ)

The SPQ [59] is a self-report questionnaire made up of 74 items with dichotomous response format (Yes/No or True/False) designed to measure DSM-III-R [189] schizotypal personality disorder. The questionnaire consists of nine subscales, corresponding to the symptoms of schizotypal personality disorder that appear in the DSM-III-R: odd beliefs or magical thinking, unusual perceptual experiences, ideas of reference, paranoid ideation/suspiciousness, excessive social anxiety, no close friends, constricted affect, odd or eccentric behavior, and odd speech.

The factor structure of the SPQ has been a matter of investigation as well as debate [100–102, 185, 190]. Studies of community subjects resulted in Raine's three-factor model of the SPQ, which included cognitive-perceptual, social-interpersonal, and disorganization dimensions. In addition to Raine's [190] three-factor model of schizotypy and schizotypal personality disorder, Stefanis et al. [191] offered an alternative four-factor model of the SPQ. In both of these models, the interpersonal factor included the "no close friends", "excessive social anxiety", and "constricted affect" subscales. Chmielewski and Watson [102] conducted item-level structural analysis of the SPQ and concluded that Raine's three-factor solution could not be replicated. Rather, their analyses supported a five-factor solution, which included a Social Anhedonia Factor. Items from the No Close Friends and Constricted Affect subscales formed the Social Anhedonia dimension. It is noteworthy that the No Close Friends subscale contains 9 items and the Constricted Affect subscale contains 8 items; thus, less than 25 % of the entire measure contains items that are directly relevant to the assessment of anhedonia. Nonetheless, psychometric studies provide some support for use of the SPQ subscales as an indirect measure of social anhedonia. As shown in Table 2.2, levels of internal consistency for the subscales ranged from 0.57 to 0.82, and the temporal stability ranges between 0.41 and 0.70. The social-interpersonal SPQ subscales showed moderate correlations with RSAS

and PAS scores or were grouped in the same underlying factor [103, 192]. The SPQ has been widely used, and translated into French, Spanish, Italian, and German as well as Chinese [104, 191, 193–195].

Two family studies [196, 197] that used the SPQ failed to reveal significant differences between relatives and controls in terms of social-interpersonal schizotypal traits. However, in a considerably larger sample of first-degree relatives of schizophrenia probands, Calkins et al. [198] observed that the social-interpersonal schizotypal factor differentiated the relatives from the comparison subjects. Indeed, they concluded that this was the SPQ factor that best differentiated relatives from controls. Similarly, Docherty and Sponheim [199] noted that relatives of schizophrenia patients reported higher levels of social-interpersonal schizotypal traits than healthy controls. Furthermore, lack of close friends appears to have some predictive value in follow-up studies, increasing the risk of full-blown psychosis [105].

The SPQ has been criticized by some investigators because all of the items are worded so that a "true" or "yes" response contributes to a high score, thereby rendering the scale subject to an acquiescence response bias [84]. The dichotomous response format may have contributed to the somewhat lower internal consistency estimates of the SPQ, relative to other measures. Wuthrich and Bates [103] partly allayed these concerns when they adapted the SPQ to a Likert-type response format. One issue concerning the SPQ is that the social-interpersonal factor encompasses both social anxiety as well as social anhedonia; as others have noted (see, for example [200]), social anxiety is a nonspecific risk factor not specifically related to social anhedonia.

The SPQ has also been criticized due to the length of the measurement instrument. Raine and Benishay [63] developed an abbreviated version of the SPQ, the Schizotypal Personality Questionnaire-Brief (SPQ-B). The SPQ-B contains 22 items and scales for three factors, namely, the Cognitive-Perceptual Deficits, Interpersonal Deficits, and Disorganization Scales. The SPQ-B was reported to have adequate reliability and correlated well with the full measure [63]. The Interpersonal Deficits scale, which is most relevant to measuring anhedonia, contains 8 items. The SPQ-B generated considerable research interest and has been translated into Spanish [201], Turkish [202], Japanese [203], and Chinese [204]. The SPQ-B appears to have a three factor structure in adolescent psychiatric inpatient and nonpatient community samples [63, 201, 205, 206]. However, while generally showing adequate internal consistency, some investigators reported that the SPQ-B failed to conform to a three-factor solution [202, 207, 208]. Also, a Likert version of the SPQ-B has been developed [205, 209]. However, neither the total or Interpersonal subscale scores of the SPQ-B differentiated first-degree relatives of schizophrenia-spectrum probands from nonpsychiatric controls [208].

More recently, Cohen et al. [101] provided an alternative abbreviated version of the SPQ, known as the Schizotypal Personality Questionnaire-Brief-Revised (SPQ-BR). The impetus for Cohen's revision appears to have been twofold: the Interpersonal subscale of the SPQ-Brief reflected both social anxiety and social anhedonia, though these are very different and distinct constructs; and the forced choice-dichotomous response format of the full version limited the reliability and

sensitivity for the abbreviated version. The revised SPQ-B retains 32 of the original 74 items and is scored on a 5-point Likert-based response format. In the SPQ-BR, there are seven trait subscales, which result in a three or four factor higher-order structure. In the SPQ-BR, the No Close Friends/Constricted Affect subscale is separate from the Social Anxiety subscale. Moreover, the psychometric properties look encouraging. The internal consistency estimate for the No Close Friends/Constricted affect subscale is 0.81 in an undergraduate sample [101]. Although this measure is relatively new, it is being increasingly incorporated into research investigations of schizotypy [210]. It is unclear whether it will be adopted as an indirect measure of anhedonia.

2.3.2.5 The Oviedo Questionnaire for Schizotypy Assessment (ESQUIZO-Q)

Adolescence is a developmental period of special risk for schizophrenia-spectrum disorders [211]. Early detection of precursors or clinical signs in individuals at high-risk for schizophrenia spectrum disorders is necessary for preventive and/or early intervention efforts [212]. Thus, efforts have also been directed at the assessment of anhedonia (a core component of schizotypy) in this age group. A good example of these self-reports are the Junior Schizotypy Scales (JSS) [213], the Schizotypy Traits Questionnaire (STA) for children [214], Schizotypal Personality Questionnaire-Child [215], and the ESQUIZO-Q [60].

The ESQUIZO-Q [60] is a self-report composed of 51 items in a 5-point Likert-type response format, ranging from 1 (*completely disagree*) to 5 (*completely agree*) that is designed to assess schizotypal traits in adolescents. The ESQUIZO-Q is based on the diagnostic criteria proposed in the DSM-IV-TR [216] and on Meehl's schizotaxia model [11] regarding genetic predisposition to schizophrenia. The items of ESQUIZO-Q were selected on the basis of an exhaustive review of the literature on schizotypy [185]. Its construction was conducted following the proposed steps for the construction of measurement instruments [217] and the guidelines for multiple-choice item construction [218]. The ESQUIZO-Q comprises a total of 10 empirically derived subscales: Ideas of Reference, Magical Thinking, Unusual Perceptual Experiences, Odd Thinking and Language, Paranoid Ideation, Physical Anhedonia, Social Anhedonia, Odd Behavior, Lack of Close Friends and Excessive Social Anxiety. These subscales are grouped into three general dimensions: Reality Distortion, Anhedonia, and Interpersonal Disorganization. The internal consistency values for the Anhedonia dimension and subscales ranged from 0.62 to 0.77. There were no gender differences on any of the Anhedonia items. Furthermore, the Anhedonia dimension of the ESQUIZO-Q was correlated with other measures that assess emotional and behavioral problems, depressive symptoms and maladaptive personality traits [128, 219, 220]. Thus, there is good evidence of convergent validity for the Anhedonia dimension of the ESQUIZO-Q.

Although the ESQUIZO-Q is a useful tool for assessing anhedonia in the general adolescent population, it was not been developed specifically for that purpose.

One direction for future research would be to examine the relationship between ESQUIZO-Q scores with other measures of hedonic capacity in adolescent representative samples [221]. To date, the ESQUIZO-Q has only been administered to Spanish adolescents.

2.3.2.6 Temporal Experience of Pleasure Scale (TEPS)

The TEPS [19] was designed to measure individual trait dispositions in both anticipatory and consummatory experiences of pleasure. This 18-item self-report measure consists of 2 subscales: a 10-item anticipatory pleasure scale and an 8-item consummatory pleasure scale. The TEPS is scored in a 6-point Likert-type response format ranging from 1 (*very false for me*) to 6 (*very true for me*). Typically, the anticipatory and consummatory scales are scored separately and compared.

The TEPS has attracted considerable research interest since its introduction in 2006. The psychometric properties of the TEPS have been extensively studied in both clinical and nonclinical samples (see Table 2.2) [19, 44, 83, 130–136]. Research indicates that the TEPS-ANT subscale is internally consistent in schizophrenia and schizophrenia-spectrum patients (coefficient alpha's range from 0.71 to 0.79) and nonpatient controls (alpha's range from 0.64 to 0.74). Similarly, the TEPS-CON subscale appears internally consistent in both schizophrenia-spectrum patient samples (coefficient alpha's range from 0.68 to 0.78) and nonpatient controls (alpha's range from 0.64 to 0.71). The temporal stability of the TEPS-ANT and TEPS-CON subscale assessments have also been measured. In one report based upon 19 schizophrenia patients, the TEPS-CON subscale appeared to show significantly higher stability than the TEPS-ANT (ICC of 0.93 versus 0.74, respectively), and a greater sensitivity to individual differences in hedonic experience [137]. In contrast, on the basis of comparison of the test-retest scores of 51 schizophrenia-spectrum patients after a 6 month interval, Buck and Lysaker [135] observed that the TEPS-ANT showed greater temporal stability than the TEPS-CON. Clearly, there is a need for further study of the temporal stability of the TEPS-ANT and TEPS-CONS, and their relationship with various measures of clinical and psychosocial functioning.

Although factorial studies of the original version of the TEPS consistently confirmed the presence of the two factors, factor analysis of the 19-item Chinese version of the TEPS [134] revealed a four-factor structure, consisting of contextual consummatory, consummatory abstract, anticipatory context, anticipatory abstract factors. The Chinese version of the TEPS substitutes two items, thereby adding more interpersonal content to the measure. The two versions of the TEPS are otherwise similar in terms of their psychometric properties [132, 134]. There is also an 18-item French translation of the TEPS [133] that has psychometric characteristics similar to the original version developed by Gard and colleagues [19].

While there is little question that many patients with schizophrenia display a pleasure deficit, to date, findings regarding the nature of relationship between schizophrenia and anhedonia as defined by the TEPS have been mixed. Several investigations have demonstrated that the TEPS successfully discriminates patients

with schizophrenia from healthy controls in terms of anticipatory pleasure deficits but not consummatory pleasure [131, 133]. However, there have been three reports [137, 222, 223] indicating that schizophrenia patients do not show an anticipatory pleasure deficit. Interestingly, the findings of Strauss et al. indicated that schizophrenia patients differed from matched healthy controls in terms of displaying deficits in consummatory pleasure, rather than anticipatory pleasure deficits. Cassidy et al. [222] found no difference in either anticipatory or consummatory pleasure between their psychotic patient sample and controls. It is noteworthy, however, that this sample included some patients with affective psychoses in addition to schizophrenia-spectrum patients.

Supportive evidence for the convergent validity of the TEPS-ANT comes from reports of its associations with other established measures. In schizophrenia patients, TEPS-ANT scores have been associated negatively with PAS scores and RSAS scores [131, 136, 137] as well as significantly and positively associated with SANS ratings of anhedonia [131] and PANSS emotional discomfort symptom ratings [135]. Scores on the TEPS-ANT have also been found to be significantly related to scores on the Carver and White [224] Behavioral Activation Scale (BAS) [19, 131, 137] in schizophrenia patients. In controls, TEPS-ANT scores correlate negatively with the PAS [19, 136, 137] and RSAS [136], and positively with the BAS [19, 137] and the Fawcett-Clark Pleasure Scale scores [19].

There is also evidence for the validity of the TEPS-CONS. As expected, there is a somewhat different pattern of associations for the TEPS-CONS, compared to the TEPS-ANT. In schizophrenia patients, scores on the TEPS-CONS are significantly and negatively associated with the PAS [131, 136, 137] and the RSAS [136]. TEPS-CONS scores have also correlated with positive symptom ratings in schizophrenia patients [135] and BAS scores [137]. In controls, the TEPS-CONS correlates significantly and positively with the BAS [19, 137] and Fawcett-Clark Pleasure Scale [19] and significantly and negatively with the PAS [19, 34, 137]. Findings regarding the relationship between the TEPS-CON and the RSAS in nonpatient samples are mixed; there are positive reports of a negative association [34, 136] along with reports of no significant association between the two scales [19, 137].

Overall, there is considerable enthusiasm for the TEPS, because of its sound psychometric properties and its relative brevity. However, the measure has been criticized for its scant item coverage of social anhedonia [130, 137]. In summary, the major contribution of the TEPS is that it makes a clear distinction consummatory pleasure and anticipatory pleasure.

2.3.2.7 Anticipatory and Consummatory Interpersonal Pleasure Scale (ACIPS)

The ACIPS [33, 61] was specifically designed to measure individuals' ability to look forward to interactions with other people (anticipatory social pleasure) as well as their ability to experience pleasure about social/interpersonal interactions when they occurred (consummatory social pleasure). It is a self-report measure composed

of 17 (7 anticipatory and 10 consummatory) items that are scored on a 6-point Likert scale (ranging from *very false for me* to *very true for me*). Abnormally low scores are interpreted as indicating social anhedonia, a decreased interest or deficit in pleasure in interpersonal stimuli, interactions, and situations. Given the developers' conceptualization of social anhedonia as an individual differences trait that is distributed dimensionally throughout the population, the ACIPS was constructed for administration to nonclinical as well as clinical (at-risk, patient) populations. The measure is relatively new; empirical efforts to derive norms for various populations are ongoing. To date, research findings indicate high internal validity (coefficient alpha = 0.86) for two independent samples [33, 34]. Test-retest reliability was 0.78 for 496 subjects with an interval between testings of 5–8 weeks [33].

Scores on the ACIPS have been observed to be significantly and positively associated with reward responsiveness, as measured by the BAS [33] , and anticipatory and consummatory pleasure, as measured by the TEPS [33, 34]. Scores on the ACIPS were negatively associated with social anhedonia and physical anhedonia scales. Within a group of patients with broadly-defined schizophrenia-spectrum disorder, the anticipatory and consummatory subscales of the ACIPS were significantly and negatively associated with PANSS social withdrawal and social avoidance symptoms, respectively [138]. To date, individuals with psychometric schizotypy score lower on the ACIPS than nonschizotypal individuals. Preliminary findings indicate that individuals with broadly-defined schizophrenia-spectrum disorders reported significantly less social-interpersonal pleasure in both the anticipatory and consummatory domains, in comparison with the control group [138]. At present, factor analysis of ACIPS data from undergraduate samples did not distinguish between temporal aspects of interpersonal pleasure, though there was clear support for distinction between factors related to general versus more intimate aspects of social/interpersonal pleasure. Larger patient samples are needed to examine the factor structure of the ACIPS in clinical populations. These preliminary findings indicate that the ACIPS is a reliable and valid way to assess hedonic capacity for social interaction and interpersonal engagement in both clinical and non-clinical samples.

2.4 Conclusions and Future Directions

The construct of anhedonia, as the reduction of pleasure, has a long history in descriptive and experimental psychopathology. With the advent of neuroimaging, and advances in our understanding of affective neuroscience, the construct of anhedonia has broadened considerably. One of the advances in affective neuroscience has been the distinction between appetitive pleasure versus consummatory pleasure. Thus, anhedonia is now described not only in terms of content domains, but also in terms of its temporal components. Increasingly, measures of negative symptoms involve asking respondents to distinguish between their future-oriented (i.e., anticipated) experiences and their actual participatory (i.e., consummatory) experiences.

Issues regarding the conceptualization of anhedonia remain, which in turn, present challenges for its assessment. There are strong arguments in favor of a dimensional approach to anhedonia. Anhedonia is seen in healthy individuals, at-risk subclinical states and clinical syndromes [24]. However, it is unclear whether the anhedonia observed in patient groups is qualitatively different from that observed in individuals in the general population. Thus far, few studies have addressed this issue, and most of the available measures for assessing anhedonia have been validated for patients with schizophrenia. It is unclear whether some of the newer instruments are sufficiently sensitive to detect mild variations in anhedonia that may be present in the general population as well as in at-risk subclinical groups.

Although there appears to be empirical evidence for an association between anhedonia and schizotypy, many investigators question whether anhedonia is best thought of as an individual difference across individuals with schizophrenia, or whether anhedonia characterizes a specific subtype of schizophrenia [24, 40]. While anhedonia is not observed in all patients with schizophrenia, it is observed in a sizable proportion of them, as well as their first-degree relatives. We are intrigued by the special relationship between schizotypy and anhedonia. To that end, we have identified several research questions:

(a) Is the anhedonia experienced by individuals in the schizophrenia-spectrum qualitatively different from that experienced by individuals with other disorders, and if so, in what way(s)? That is, is there a continuum of anhedonia frequency and intensity across disorders?
(b) When in the developmental ontogeny of the schizophrenia-spectrum disorder, does anhedonia first become manifest? Do the manifestations of anhedonia change over the life-course? How can we use this knowledge about anhedonia to better inform our interventions, especially in terms of early intervention work?
(c) What is the best way to parse the anhedonia deficit experienced by many individuals in the schizophrenia-spectrum?
(d) Given the often limited experience of individuals at the more severe end of the schizophrenia spectrum, are the current measures assaying the right types of experiences? That is, how sensitive are they to the variations in patients' range of interpersonal experiences? Patients vary in terms of romantic histories, size and quality of social networks, which may or may not correlate with the age of onset of their schizophrenia-spectrum disorder.
(e) How might extant accounts for anhedonia in schizophrenia-spectrum disorders help us understand shared mechanisms with other brain disorders (e.g., major depression, bipolar disorder)?
(f) How might understanding of anhedonia in schizophrenia-spectrum disorders help elucidate the heterogeneity within the spectrum?

At present, there are several measurement instruments available for clinicians and researchers to document the presence, frequency, and severity of anhedonia symptoms and traits. The SANS is perhaps one of the best known and most widely used measures of schizophrenic symptoms. It differs from the other interview-based

measures in that it combines anhedonia and asociality into one subscale. There may be some advantages to this practice, given that anhedonia appears to be a multidimensional construct, whereas asociality seems to be taxonic in nature [184]. Moreover, the extent to which anhedonia and asociality can be differentiated in social anhedonia is unclear.

In contrast to the SANS, both the two new interview-based assessments of negative symptoms, namely, the CAINS and the BNSS, distinguish between social anhedonia and asociality. Anticipatory and consummatory aspects of pleasure are also distinguished from each other in the CAINS and BNSS. Across all three of the interview-based measures reviewed, anhedonia and avolition seem to be closely associated with each other. In the two newer interviews, anhedonia falls under the general Motivation and Pleasure factor. In the SANS, anhedonia-asociality and avolition are highly correlated with each other. It would be useful to gather evidence regarding whether the brain circuitry underlying avolition is distinction from the neural circuitry underlying the various components of hedonic experience, namely, anticipated, experienced, and remembered pleasure. One necessary future direction for this area would be to administer the newer measures to other patient populations. The CAINS and BNSS were pilot tested on schizophrenia outpatients. Nonetheless, it would be helpful to administer these measures to other patient populations, in order to determine the relative specificity of aspects of anhedonia to schizophrenia, as well as to accommodate the new conceptual framework of the RDoC [225].

The corpus of literature on the concurrent, predictive, and construct validity of the Chapman social anhedonia and physical anhedonia scales is impressive. Rather than attempt to shorten this measure which works so well empirically, it would seem prudent to take steps to improve upon its content validity by updating some of the items. This process of updating the items would be similar to what investigators have done with the MMPI. Despite its length, the MMPI [226] and the MMPI-2 [32] remain among the most widely used personality inventories clinically and in the research arena. The SPQ-BR appears to address many of the limitations of the earlier versions of the abbreviated SPQ, and may provide a quick alternative for those individuals interested in screening for schizotypal personality disorder. Fortunately, however, there appear to be other measures that appear to be more predictive assays of schizotypy and anhedonia.

The ESQUIZO-Q stands out among the extant self-report instruments as one of the sole measures of schizotypy developed for an adolescent sample. The psychometric data look promising, given the importance of early detection and the prognostic significance of anhedonia, it will be key for the developers of the measure to determine its external validity in terms of other cultural groups, as well as its relationship with other measures of hedonic capacity. Indeed, prior studies have indicated the predictive value of anhedonia during adolescence in at-risk individuals [147].

Both the TEPS and ACIPS appear to be promising measures of hedonic capacity in both clinical and nonclinical populations. The TEPS may be limited by its relative paucity of items pertaining to social pleasure. Although there is some question regarding whether the temporal aspects of pleasure can be reliably distinguished in

the ACIPS, its strength appears to be in its focus on social/interpersonal pleasure. However, given the brevity of these two measures, there may be some incremental value in administering them jointly. Together the TEPS and ACIPS form a complementary set of 35 items that could provide an assessment of both temporal aspects and content domains related to anhedonia.

Based on this review, it appears that anhedonia can be assessed in a reliable and valid manner in individuals with a schizophrenia-spectrum disorder, using either a clinical interview or a self-report questionnaire. Depending upon the measure chosen, one could describe the relative amount and severity of the self-reported anhedonia. However, it might be difficult to discern the underlying cause of the anhedonia, and to determine whether the anhedonia was primary or secondary to medication or an environmental factor. For example, an individual with a schizophrenia-spectrum disorder may have a low level of actual participatory experiences in pleasurable events due to lack of finances, lack of opportunity, lack of social skills, or lack of actual desire to engage in the pleasurable experience; only the last of these possible reasons truly constitutes consummatory anhedonia. Similarly, an individual with a schizophrenia-spectrum disorder may express reduced anticipatory pleasure due to an inability to predict future events, secondary to impaired encoding-retrieval for positive stimuli and events [21], a lack of experience with the pleasurable events, or an inability to pair positive valence with the stimulus [22]. It is not clear how one disentangles the different underlying causes for self-reported anhedonia.

Ideally, the selection of assessment instrument should be guided by one's clinical and/or research question. That is, the type of measure chosen will depend in part on the population of interest, the assessment question, and the context (e.g., clinical trial, family study or genetic study, risk screening, etc.). For the purpose of clinical trials, in order to test the effectiveness of a pharmaceutical agent or psychosocial intervention, a brief measure that is temporally reliable yet sensitive to clinical changes and includes fine-grained distinctions between various aspects of pleasure would be advantageous. On the basis of these criteria, the SANS and BNSS seem best suited for clinical trials. If one's goal is to detect heightened risk for the later development of a schizophrenia-spectrum disorder, it would seem more prudent to opt for thoroughness rather than brevity, and select a measure that assesses trait-anhedonia. It would be important to select a measure that not only reliably distinguishes between patients and nonpatient controls, but one that also has demonstrated predictive validity. Furthermore, it would be best to look for an instrument that successfully distinguishes first-degree relatives of schizophrenia probands from relatives of healthy controls. On the basis of these criteria, it appears that the PAS and RSAS are best suited for inclusions in family studies of anhedonia, as well as studies for risk prediction. The ESQUIZO-Q looks promising for use with adolescents; the Chapman scales are not appropriate for this age group.

One pressing need that this review revealed was the need for more cross-cultural research, in order to analyze the measurement invariance of anhedonia profiles across different samples. Accompanying this of course is the need for increased translation efforts; the early intervention research area would likely benefit from

developmentally-appropriate measures such as the ESQUIZO-Q. In addition to studying different ages, examination of possible gender, cultural, and/or ethnic differences may provide greater insights into how best to parse the construct of anhedonia.

Advances in new measurement models and statistical procedures, such as IRT, or computerized adaptive testing (CAT), have not yet been used to advantage in the study of individual differences in, anhedonia and the ability to experience pleasure. As a complement to classical test theory, the IRT framework could resolve some of the limitations present in the anhedonia field [227, 228]. IRT models can be useful for the interpretation of test scores and for directly comparing scores obtained by different scales or self-reports which measure the same construct (i.e. ordinal scales). Moreover, through IRT, an Item Characteristic Curve is constructed for each item. This curve, or trace line, reflects the probability of the person's response to each item and his/her level on the latent construct (e.g., anhedonia) measured by the scale. Furthermore, IRT allows us to estimate the contribution each item makes to the assessment for each level of the latent construct; this is known as the Information Function. Recent work has used the IRT framework in the assessment of anhedonia and negative symptoms [53, 188].

Another application of IRT is computerized adaptive testing (CAT) [229]. In CAT each item is dynamically selected from a pool of items until a pre-specified measurement precision is reached. CAT successively selects items in order to maximize the precision of the measurement instrument based on what is known about the person from previous items. The essential idea is that when adjusting the items to the competency (or latent trait) of the test taker, once these are calibrated according to an IRT model far fewer items are needed to assess individuals with precision in comparison to paper-and-pencil tests. Thus, items and time are saved through the use of precision and efficiency. Our research group has preliminary data which suggests that CAT can be used effectively to evaluate schizotypy in non-clinical adolescents [230]. Future research efforts should be invested in applying this IRT-based technique to the study of anhedonia.

In summary, since 2005, the schizophrenia field has been experiencing a Renaissance in terms of the assessment of negative symptoms, particularly anhedonia. Several new measures were developed which differ in potentially interesting and important ways. The CAINS and the BNSS are new interview-based measures, whereas the ESQUIZO-Q, TEPS, MAP-SR and ACIPS are recent self-report questionnaires. We are encouraged by these new developments and hope that they can be harnessed in order to lend further insights regarding the special relationship between anhedonia and schizotypy and ameliorate the lives of those affected by schizophrenia and schizophrenia-spectrum disorders.

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