

Chapter 9

Anhedonia and Negative Symptom Schizotypy

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Abstract Current conceptualizations of schizophrenia indicate that the underlying vulnerability for the disorder is expressed across a broad continuum of impairment referred to as schizotypy. Trait-like anhedonia has long been recognized as a central component of schizophrenia and schizotypy. Our understanding of the etiology, experience, and expression of anhedonia, however, has evolved in large part due to advances in social and emotion psychology regarding the nature of pleasure, advances in the neurosciences regarding the brain mechanisms underlying hedonic capacity and experience, and the integration of measures from clinical, social, and biological psychology. Current studies have differentiated deficits in anticipatory pleasure from deficits in consummatory pleasure. The study of anhedonia has also been enhanced by the use of experience sampling research methods that expand investigations from the laboratory and the clinic to real world environments. Anhedonia appears to be a core component of the negative or deficit symptom dimension of schizotypy and schizophrenia, whereas the positive or psychotic-like dimension appears to be characterized by affective dysregulation. Furthermore, schizotypic anhedonia is differentiated from conditions such as depression, which involve episodic anhedonia combined with elevated negative affect. The present chapter presents an overview of theoretical conceptualizations of anhedonia in schizotypy, reviews cross-sectional, longitudinal, and daily life research findings, and considers issues and directions for future study of the construct.

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Abbreviations

ESM	Experience sampling methodology
NEO-PI-R	NEO Personality Inventory-Revised
TEPS	Temporal Experience of Pleasure Scale
COMT	Catechol-O-methyltransferase
VAL	Valine
BOLD	Blood Oxygenation Level Dependent
fMRI	functional magnetic resonance imaging

9.1 Introduction and Overview

Trait-like anhedonia or deficits in the anticipation and experience of pleasure have long been recognized as central aspects of the schizophrenia spectrum. These deficits not only represent symptomatic outcomes of these disorders, but also appear to play an important role in the etiology and development of these conditions and seem to be part of the broader phenotype of schizotypy. However, our understanding of the etiology, experience, and expression of anhedonia, has developed dramatically given recent advances in social and emotion psychology regarding the nature of pleasure, advances in the neurosciences regarding the brain mechanisms underlying hedonic capacity and experience, and the integration of measures from clinical, social, and biological psychology. The present chapter provides an overview of theoretical conceptualizations of anhedonia in schizotypy, reviews cross-sectional, longitudinal, and daily life research findings, and considers issues and directions for future study of the construct. Furthermore, the chapter argues that schizotypy and schizophrenia must be conceptualized as multi-dimensional constructs and that anhedonia is a central component of the negative symptom dimension of schizotypy and schizophrenia.

9.2 Schizotypy, Schizophrenia, and Anhedonia

Despite well over 100 years of study, the exact causes of schizophrenia continue to evade researchers. However current etiological models assume that genetic and environmental factors beginning in utero initiate a pattern of neurodevelopmental risk that interacts with biopsychosocial stressors across development to leave the individual at heightened risk for the onset of schizophrenia-spectrum symptoms

and disorders [1, 2] The manifestations of this vulnerability are referred to as schizotypy, and are expressed over a dynamic continuum of severity ranging from relatively healthy or minimally impaired functioning, to abnormal but subclinical deviance, to clinically significant personality disorders, to full-blown psychosis (e.g., [3–6]). As such, schizotypic individuals are at heightened risk for developing schizophrenia-spectrum psychopathology; however, this risk does not make future disorders inevitable. In fact, only a minority of schizotypes will actually go on to develop schizophrenia; however, many others will exhibit mild schizophrenic-like deficits, symptoms, or impairment [7]. Expanding the definition of schizophrenia to a broader continuum of clinical and subclinical manifestations that captures the breadth of these symptoms provides a promising framework for understanding the etiology, expression, and treatment of schizophrenia and related disorders.

Schizotypy, and by extension schizophrenia, is a heterogenous construct in terms of etiology, expression, and trajectory. This heterogeneity appears to be captured in a multidimensional structure, with two or more underlying factors. Consistent with multidimensional models of schizophrenia, positive and negative schizotypy factors are the most reliably replicated, and cognitive disorganization, paranoia, nonconformity and other factors have been implicated as well [7, 8]. A universally agreed upon latent structure of schizotypy has not been established, however these proposed factors are consistent with the positive, negative, and disorganization symptom dimensions hypothesized to underlie schizophrenia [9–11]. Positive schizotypy is comprised of magical, suspicious, and referential thinking, and perceptual abnormalities, which are expressed as delusions and hallucinations in schizophrenia [7, 12, 13]. Negative schizotypy, on the other hand, includes flat or blunted affect, avolition (lack of motivation), alogia (poverty of thought and speech), social disinterest, and anhedonia that are expressed at increasing levels as one approaches full-blown schizophrenia spectrum disorders [7, 14]. Barrantes-Vidal et al. [15] argued that the “conceptualization and measurement of schizotypy and schizophrenia as multidimensional are essential for advancing our understanding of these constructs. Studies that treat them as homogenous often produce mixed, equivocal, or non-replicable results because these dimensions are associated with distinct etiologies, presentations, and treatment responses.” (p. 50).

9.3 Schizotypic Anhedonia

Anhedonia is defined as markedly diminished interests and deficits in the experience of pleasure that have consistently been identified as a core component of negative schizotypy and schizophrenia [16, 17] Schizotypic anhedonia may be manifested in various forms, including deficits in sensory and aesthetic pleasure associated with eating, touching, feeling, sex, temperature, movement, sight, and sound (often referred to as physical anhedonia), and a lack of motivation to engage in social interactions (asociality), lack of pleasure when in social situations, and indifference towards others (known as social anhedonia). There appears to be a cognitive component of

anhedonia that includes both beliefs about diminished expectations of pleasure that impact reporting of noncurrent feelings, as well as impairment in memory processes such as encoding and retrieval that serves to maintain these impaired beliefs and expectation despite the actual experience of positive emotional states [18]. These features of schizotypic anhedonia are present in an exacerbated form among patients with schizophrenia, such that there can be markedly diminished enjoyment associated with all activities, and very low, if any, interest in or pleasure from social contact.

Ample evidence suggests that anhedonia is elevated among people with schizophrenia [19–21] nonclinical schizotypes [7, 22], and first-degree relatives of schizophrenic probands [23]. Longitudinal research has demonstrated that schizotypic anhedonia is a long-term, stable characteristic related to personality factors, as opposed to the more state-dependent anhedonia associated with clinical symptoms in other disorders such as depression [14, 24, 25]. There is mixed evidence regarding the relationship among anhedonia and the other symptoms of schizotypy and schizophrenia, likely due in part to limitations in definition and measurement [14]. However there is ample evidence to suggest that anhedonia is associated with other negative symptoms and is distinguishable from symptoms within other (non-negative) dimensions in both schizotypy and schizophrenia research (e.g., [7, 26–28]). Further, anhedonia represents diminished hedonic functioning, which is consistent with the classification of negative symptoms as deficiencies in normal functioning. Overall, there is sufficient evidence to suggest that anhedonia is a core component of the negative symptom dimension.

9.4 Social Anhedonia

Social psychologists conceptualize humans as social animals, with a basic drive for belongingness and close interpersonal relationships [29, 30]. As identified above, social anhedonia, or asociality and indifference towards others, is a form of anhedonia that is commonly distinguished from physical anhedonia in the literature. Diminished motivation to engage in social contact, and decreased pleasure experienced from doing so, are particularly striking in light of the basic human need to form strong and enduring social attachments, and to engage in frequent interpersonal interactions [31, 32]. People high in social anhedonia experience a reduced or absent drive for social contact and relationships, resulting from diminished positive affect experienced during social situations (as compared to people without social anhedonia; [33]). Social anhedonia is distinguished from social anxiety, in which avoidance is driven by social discomfort/anxiety, and from paranoia, in which avoidance is driven by a belief that others are dangerous. In both social anxiety and paranoia, reduced social interactions are driven by elevated negative affect, not by reduced positive affect or approach motivation [33, 34]. It should also be noted that social anhedonia does not refer to normative behavior such as the enjoyment of solitary activities, or personality traits such as

introversion [35]; instead, it is defined as a stable, trait-like disinterest in social contact and diminished pleasure in social settings [32].

Like anhedonia in general, social anhedonia is associated with several psychiatric disorders (e.g., schizoid personality disorder), and is conceptualized as a core component of negative schizotypy, and by extension, the negative-symptom dimension of schizophrenia [32]. Studies have consistently reported a relationship between social anhedonia and negative schizotypy (e.g., [7, 36]) and schizophrenia (e.g., [21]) and longitudinal research indicates that social anhedonia predicts the development of schizophrenia-spectrum symptoms and disorders [22, 37, 38]. Further, social anhedonia is related to poorer overall functioning [38] and may further increase risk for schizophrenia by removing the benefits of social support [22].

9.5 Contrasting Schizotypic Anhedonia with Depressive Anhedonia and Normal Personality

A natural question concerns how the anhedonia that characterizes negative schizotypy differs from other expressions of anhedonia. The most salient contrast is with depressive anhedonia, which is also characterized by heightened physical anhedonia (e.g., diminished pleasure from previously enjoyable activities) and social anhedonia (e.g., heightened solitude, social withdrawal, and social disinterest).

We argue that two major points of difference distinguish depressive anhedonia and the anhedonia characteristic of negative schizotypy. First, the anhedonia seen in depression is episodic: people show heightened anhedonia during episodes of normal dysphoria or clinical depression and then return to their prior levels of physical and social interest and enjoyment. A study by Blanchard, Horan, and Brown [24], for example, examined the time course of social anhedonia in a sample of adults with either schizophrenia, clinical depression, or no disorder. At the start, both the depression and schizophrenia groups had significantly higher levels of social anhedonia. After 1 year, however, social anhedonia had declined in the depression group but remained elevated in the schizophrenia group, a finding consistent with the view of anhedonia as a transient feature of a depressive episode. Second, depressive anhedonia is typically accompanied by the heightened negative affect typical of depression, but negative schizotypy is not. Many cross-sectional and experience-sampling studies, for example, have shown that only positive, not negative, schizotypy routinely predicts heightened negative affect (e.g., [7, 15, 38]). Instead, negative schizotypy, as one would expect, more commonly reflects diminished affect for a range of positive and negative states.

Another worthwhile contrast is between negative schizotypy and normal dimensions of personality. As one would expect, self-report measures of negative schizotypy correlate moderately with self-report measures of individual differences in normal personality traits. In a large-sample study reported by Kwapil et al. [7], 780 young adults completed the NEO-PI-R, a broad measure of the five major factors of personality, along with questionnaire measures of schizotypy which were

then formed into positive and negative factor scores. Negative schizotypy, largely characterized by anhedonia, had significant negative associations with extraversion (positive affectivity), openness to experience, and agreeableness. Note that negative schizotypy was not significantly associated with neuroticism (negative affectivity). The pattern of findings is consistent with our characterization of negative schizotypy. In contrast, positive schizotypy, which is characterized by negative affect and affective dysregulation, was positively associated with neuroticism, but unassociated with extraversion—nicely demonstrating the differentiation of positive and negative schizotypy in terms of affectively laden personality dimensions. Specifically, negative schizotypy is characterized by diminished social engagement and positive affect typical of extraversion; diminished curiosity, rich inner experience, and subtle emotional experience typical of openness; and diminished social engagement typical of agreeableness.

We should note that these findings speak against a simple interpretation of negative schizotypy as merely “high introversion,” in which people display both the low positive affect and low gregariousness. Negative schizotypy has a more rounded profile of relationships with other individual differences, such as openness and agreeableness, as we have seen. Moreover, people low in normal extraversion typically show features that speak against social anhedonia. Normal introversion is linked to shyness and normal social fears, which indicate normal social interest: people who are shy and socially anxious seek social belongingness like nearly everyone else but have dysfunctional beliefs that make forming those connections stressful. In negative schizotypy, however, the high social anhedonia reflects social disinterest, in which people are unconcerned with forming normal relationships.

9.6 Historical Roots of Anhedonia in Schizotypy and Schizophrenia

The concept of anhedonia is represented in the landmark writings of Kraepelin [39] and Bleuler [40] who both identified reduced pleasure capacity as an important feature of “dementia praecox” or schizophrenia. Rado’s [41] model of the development of schizophrenia included an “integrative pleasure deficiency” that was pervasive across all areas of life and included a reduced capacity for sympathy, affection, and ability to function in family or other groups. Building upon Rado’s [17, 41] formulations of anhedonia (and schizotypy in general) as a genetically transmitted trait, Meehl [6, 16] developed his landmark theory of schizotypy, which included a pervasive pleasure deficit as central to schizotypy and schizophrenia. Taking issue with the severity of Rado’s terminology (anhedonia literally means a complete lack of pleasure), Meehl [42] later coined the term hypohedonia, defined as an impaired disposition to experience pleasure, and a diminished effect of positive reinforcement in future learning. Despite this, the majority of the subsequent literature on the topic has maintained the use of the term anhedonia to refer to this fundamental

hedonic deficit. Meehl's later writings (e.g., [6]) diminished the role of anhedonia in his theory, despite his initial formulations identifying anhedonia as a central component of schizotypy. Specifically, he suggested that anhedonia, especially in the social domain, may be a result of secondary, polygenic factors of a continuous nature, as opposed to a core, etiological characteristic of the schizotypy taxon.

In contrast to Meehl's later revisions, subsequent research has suggested that social anhedonia is taxonic in nature [43] and is a powerful predictor of the future development of schizophrenia and related disorders [22, 38]. Overall, anhedonia, including physical, social, and other deficits in the motivation to seek out or experience pleasure, is a core component of negative schizotypy and schizophrenia, and understanding its etiology, development, and treatment is essential for elucidating the multidimensional nature of schizophrenia. Approaching the study of anhedonia using a schizotypic model captures the breadth of its manifestations, ranging from mild loss of interest and pleasure to marked and pervasive anhedonia in schizophrenia, and provides a promising framework for understanding this construct.

9.7 Current Conceptualizations and Assessment of Schizotypic Anhedonia

As noted above, historical views of schizophrenia assumed that patients broadly experienced diminished pleasure. However, beginning in the 1980s and 1990s, a number of studies began to challenge some of the basic assumptions regarding anhedonia in schizophrenia. For example, as reviewed by Horan et al. [27], patients with schizophrenia often report diminished pleasure on self-report questionnaires and interviews, but do not necessarily exhibit diminished pleasure during laboratory and physiological tasks. Gard et al. [44] differentiated between anticipatory and consummatory pleasure, and reported that patients exhibit a deficit in the former, but not the latter. Furthermore, they linked deficits in anticipatory pleasure to motivational processes that are associated with reductions in goal-directed behavior, characteristic of negative symptom schizophrenia. However, as noted below, considerable controversy remains about these distinctions.

Although anhedonia has long been considered a core negative symptom of schizophrenia (e.g. [45]), its expression is captured differently across methods of assessment. A wealth of data shows elevated levels of self-reported social and physical anhedonia in patients with schizophrenia compared to healthy controls (e.g. [20]) and to patients with bipolar disorder (e.g. [21]). Likewise, diminished experience of pleasure in negative symptom schizophrenia is found using interview assessments (e.g. [46, 47]). However, some laboratory studies fail to find elevated levels of anhedonia in patients with schizophrenia as compared to controls (e.g. [48]). A meta-analysis of 26 laboratory studies showed that patients with schizophrenia experience levels of pleasure comparable to controls in response to pleasurable stimuli during emotion induction tasks (Hedges $D = -.16$; [49]). Thus it appears that

the construct of anhedonia may reflect a cognitive-perceptual bias, as well as a true experiential deficit (see [18] for a review of emotional self-report of anhedonia in schizophrenia).

Research has shown anhedonia to have a number of adverse correlates: social anhedonia in schizophrenia is associated with stress and low well-being [21], and physical anhedonia is associated with obsessiveness, low self-efficacy, and low self-esteem [14]. Within schizophrenia, both types of anhedonia are positively associated with poor premorbid functioning [50–52], low self-reported social functioning [21, 48], and emotional distress, and negatively associated with coping and perceived social support [14]. In sum, anhedonia in schizophrenia, which is primarily associated with negative symptoms, appears to be at least in part cognitive-interpretational and behavioral in nature and is linked with poor global and social functioning.

Schizophrenia represents the most severe manifestation of the schizotypic continuum. However, the diminished ability to experience pleasure manifests across the entire schizotypy spectrum; in addition to schizophrenia, anhedonia has been identified in schizophrenia-spectrum personality disorders, at-risk or prodromal patients, and non-clinical schizotypy. Advancement in the study of schizotypic anhedonia has benefitted from converging evidence across different domains of research, including—but not limited to—clinical, biological, neurological, social and personality psychology, and from a variety of assessment methods, including psychometric, interview, laboratory, psychophysiological, cross-sectional, longitudinal, and ecological assessments.

9.7.1 Assessment of Schizotypic Anhedonia

Although a variety of measures of schizotypic anhedonia have been developed, the majority of this chapter will focus on self-report, psychometric screening inventories, which have proven to be a useful method for assessing the construct. Although this method lacks the precision and specificity of other forms of assessment, such as structured interviews, it has several advantages: namely, it is relatively quick and inexpensive to administer, it is non-intrusive, and can easily be used to test large groups. Although there are a number of self-report measures that assess schizotypic anhedonia, our discussion will primarily focus on the Physical Anhedonia Scale [50] and the Revised Social Anhedonia Scale [53]. These scales were designed to measure symptoms and traits characteristic of the preschizophrenic condition, in line with descriptions from Meehl's operationalization of schizotypy [16, 54]. The Physical Anhedonia Scale assesses deficits in sensory and aesthetic pleasure, whereas the Revised Social Anhedonia Scale measures schizoid asociality and indifference to others.

Interview assessments provide an in-depth and standardized method to define and rate anhedonia. Typically, a trained clinician rates the presence and severity of various symptoms after making behavioral observations and gathering information

from the participant and other informed individuals. For example, the Scale for the Assessment of Negative Symptoms [45, 55] Anhedonia-Asociality subscale includes a severity rating from 0 to 5 for four relevant items, a subjective awareness item, and a global rating. There are a variety of interview assessments designed to measure anhedonia; the majority focus on the frequency of participation in social and recreational activities.

The benefit of using interview assessments is that they provide a level of detail that is not obtained with self-report questionnaires, although they require greater time and expense than psychometric screening measures. The main disadvantage for the study of schizotypy is that many of the interview measures were created for patients with schizophrenia and are not sensitive enough to detect variation at the level of subclinical schizotypy. However, more recent interviews of negative symptoms of schizotypy and schizophrenia include assessments of anhedonia across a broad range of the construct. These include the Structured Interview for Prodromal Symptoms [56], the Comprehensive Assessment of At-Risk Mental States [57], the Negative Symptom Manual [58], and the Clinical Assessment Interview for Negative Symptoms [59].

Even for use with patients with schizophrenia, there are a number of shortcomings of the current interview assessment systems for anhedonia and other negative symptoms (e.g. [26, 27, 60]). Problems include the use of outdated items and items that do not cohere with other negative symptoms in factor analyses. Skewed informant ratings and patient characteristics, such as cognitive deficits, retrospective bias (e.g., [18]), and blunted facial (e.g. [19, 61]) and vocal (e.g., [62]) expressivity can also lower the accuracy of data collected. Threats to validity include using observations of external behavior to infer internal states, as well as tautological reasoning in which 'functional' negative symptom criteria are used to predict functional outcomes. Other common weaknesses are measurement of the consequences of anhedonia instead of the construct itself and measurement of concepts with similar manifestations yet different underlying processes; for example, many measures cannot properly distinguish avolition from anhedonia and thus primarily tap motivational deficits. Barrantes-Vidal et al. [15] also commented that some measures of schizotypic anhedonia (and negative symptoms in general) are highly correlated with depression, in contrast to formulations of negative schizotypy. Additionally, some measures focus on frequency of engagement without capturing true in-the-moment enjoyment. This shortcoming is similar to the failure to discriminate between anticipatory and consummatory pleasure, which recent research has shown to be a key distinction.

Consummatory pleasure is experienced while directly engaging in an experience, whereas anticipatory pleasure is related to future experiences [63] and is composed of both prediction of eventual reward and momentary pleasure of the anticipation. This leads to a cyclical conceptual representation of an experience as pleasant or unpleasant as memory, anticipation, and experience interact across time [64]. Research using a scale that distinguishes anticipatory and consummatory pleasure, the Temporal Experience of Pleasure Scale (TEPS; [63]) has yielded promising, although in some cases inconsistent, results. The original findings from Gard et al. [44] indicated that patients with schizophrenia exhibited deficits in anticipatory,

but not consummatory pleasure. However, other studies have suggest that patients exhibit deficits in consummatory, but not anticipatory pleasure [65], or deficits in both forms of pleasure [66]. Furthermore, Buck and Lysaker [67] indicated that anticipatory pleasure is more stable over time than consummatory pleasure; however, this is contrasted by findings from Strauss et al. [65]. In schizophrenia, anticipatory pleasure is positively correlated with social and familial functioning [44, 67], and negatively correlated with social and physical anhedonia [44], positive symptoms [65, 67], and emotional discomfort [67]. Consummatory pleasure is negatively associated with physical—but not social anhedonia [44] and with positive symptoms [67]. A 6-month follow-up showed that low anticipatory pleasure is associated with emotional discomfort over time but that consummatory pleasure is unassociated with symptoms or quality of life at follow-up. It is therefore possible that anticipatory pleasure reflects difficulty with emotion regulation and anxiety about future social and recreational activities [67].

Although the TEPS was designed using a college sample, relationships between anticipatory and consummatory pleasure with subclinical schizotypy have remained under-researched. Initial validity studies showed both types of pleasure to be negatively associated with social and physical anhedonia and positively associated with reward responsiveness, though responsiveness to reward was more strongly linked with anticipatory pleasure [63]. These results were corroborated in Chinese [66] and American [68] samples with psychometrically identified schizotypy. Both anticipatory and consummatory pleasure were negatively associated with social and physical anhedonia in the Chinese sample, though the relationships with physical anhedonia were stronger. Interestingly, both types of pleasure were positively associated with cognitive perceptual (positive) schizotypic symptoms and negatively associated with interpersonal (negative) schizotypic symptoms [69]. In the American sample, a high social anhedonia group had lower anticipatory and consummatory pleasure than a control group [68]. Likewise, Gooding and Pflum [70] reported that social anhedonia was associated with both anticipatory and consummatory deficits on the TEPS. This suggests that the differential associations of temporal pleasure and the link between anticipatory deficits and emotion dysregulation found in schizophrenia may not be present in subclinical groups. Nonetheless, subclinical anhedonia does appear to be related to experiential deficits in pleasure across time.

The widespread use of psychometric screening measures has broadened our knowledge of associations between anhedonia and other factors. The next section provides an overview of the association of psychometrically assessed schizotypic anhedonia with cross-sectional clinical and laboratory studies, longitudinal high-risk assessments, and daily life assessments using experience sampling methodology (ESM). Associations of anhedonia have been examined in clinical and non-clinical samples. Bailey et al. [71] examined correlates of social and physical anhedonia in an adult inpatient psychiatric sample. Anhedonia measures were found to correlate positively with Axis II schizoid, schizotypal, and avoidant personality disorders (r -values = .40–.59). Likewise, within a college sample, a high social anhedonia-low magical ideation group had significantly higher schizotypal, schizoid, and paranoid clinical scores than a low social anhedonia group, while still not meeting full

diagnostic criteria for any of the three personality disorders [72]. These studies indicate that anhedonia is associated with clinically relevant symptoms, even in individuals without full-blown psychopathology.

The use of family studies and genetic techniques provides insight into the biological basis of schizophrenia. Interview assessments in siblings of patients diagnosed with schizophrenia [73], as well as interpersonal behavioral ratings—but not clinical symptom ratings—in parents of putative schizotypes [74] provide evidence for elevated levels of social anhedonia in first-degree relatives compared to the general population. Furthermore, a group of relatives of patients with schizophrenia with a homozygous VAL allele of the COMT polymorphism scored higher on physical anhedonia than non-homozygous relatives and controls [75]. Similarly, Kaczorowski et al. [76] found that a negative symptom index largely based upon physical and social anhedonia was associated with the number of COMT VAL alleles in a healthy college student sample. The association of VAL allele frequency and anhedonia/negative symptoms makes sense given that VAL allele frequency is associated with diminished dopamine availability in the prefrontal cortex—a putative mechanism for negative symptoms. Finally, research with ultra high-risk groups has shown higher levels of social anhedonia in those who eventually transition to psychosis, compared to those who do not (e.g. [77, 78]). This accumulation of evidence indicates that anhedonia is one phenotypic expression of the biological vulnerability to develop schizophrenia.

Though the use of laboratory stimuli has previously been criticized for its low ecological validity [79] the main strength is that such measures are less prone to cognitive-perceptual biases than self-report and may yield more valid results of in-the-moment hedonic capacity. Some behavioral studies have found diminished facial expressivity in individuals with social anhedonia (e.g. [80, 81]); whereas another study indicated that individuals with schizotypy display greater facial response to laboratory stimuli than controls, suggesting greater reactivity [82]. Both findings are nonetheless inconsistent with meta-analytic results from patients with schizophrenia reporting no difference in facial expressivity [83].

Another contrast with the schizophrenia literature [49] is that individuals with high levels of physical anhedonia rate pleasant and neutral stimuli as less positive than do individuals with low levels of physical anhedonia [82]. Finally, a group high in social anhedonia was rated more poorly than a low social anhedonia group on overall social skills in a laboratory social interaction paradigm [84]. This is in contrast to previous research showing physical and social anhedonia in patients with schizophrenia to be unrelated to social skills [20]. Paradoxically, behavioral results from laboratory studies tend to show a more pervasive pattern of hedonic deficit in individuals with schizotypy than in schizophrenia (see [46]). It has been suggested that the experience-expression incongruence in patients may not yet be present in subclinical individuals [80]. Studies directly comparing schizophrenia, prodromal, and schizotypic groups on behavioral measures of physical and social anhedonia may help clarify this apparent paradox.

The use of psychophysiological assessment allows examination of the potential discontinuity in response among self-report, arousal, and behavioral systems.

Whereas hedonic individuals show varying heart rate patterns for differently valenced stimuli, a college sample with high physical anhedonia showed no cardiac differentiation among positive, negative, and neutral stimuli. On the other hand, their skin conductance response and self-reported affect were comparable to that of controls [82]. However, a handful of studies have found hypo-responsive skin conductance in groups with high social and physical anhedonia (e.g. [85]; for a review, see [86]). Although the literature shows some mixed results, physical anhedonia appears to be generally associated with decreased autonomic response to stimuli.

It is commonly accepted that patients with schizophrenia have aberrations in the neural reward mechanism (e.g. [87]). Although neurological research on anhedonia in subclinical schizotypy has been limited, similar results emerge from the available literature. One group provided converging evidence from functional neuroimaging and voxel-based morphology study. They showed that functionally, physical anhedonia was associated with ventromedial prefrontal cortex activity: Blood Oxygenation Level Dependent (BOLD) response was positively correlated with processing of positive stimuli and negatively correlated with processing of negative stimuli. Structurally, physical anhedonia was associated with bilaterally reduced gray matter in the anterior caudate, a key structure in the neural reward system [88].

An fMRI study in a group with elevated ratings of physical anhedonia showed that, although self-reported psychosocial stress in response to a high-pressure mental arithmetic task was comparable to that of control and perceptual aberration groups, the physical anhedonia group had greater striatal and limbic deactivation. This is believed to reflect greater stress-reactivity and genetic vulnerability in physical anhedonia [89]. Overall, the results indicate the presence of neural correlates of diminished reward processing in anhedonia. This is consistent with reports from the schizophrenia literature of lower activation of pleasure centers in the brain in response to pleasant stimuli (e.g. [90]).

Studies have reported that physical and social anhedonia are associated with interview ratings of negative symptom. For example, Kwapil, Crump, & Pickup [91] reported that participants with elevated scores (standard scores of at least 1.96) on the Physical Anhedonia Scale ($n=73$) and the Revised Social Anhedonia Scale ($n=104$) exceeded control participants ($n=178$) on interview ratings of negative and schizoid symptoms, and Kwapil et al. [7] reported that a combined anhedonia index based upon physical and social anhedonia correlated significantly with interview ratings of negative and schizoid symptoms in a sample of 430 young adults. However, these studies did not examine the association of anhedonia with individual classes of negative symptoms. We used the data from Kwapil et al. [7] to examine the association of physical and social anhedonia, as well as from the anhedonia index, with six individual classes of negative symptoms. The sample included 430 young adults (320 women, 110 men; mean age=19.2, $SD=1.4$) who completed the anhedonia scales and underwent structured diagnostic interviews including the Negative Symptom Manual. The Negative Symptom Manual provides a total score, as well as subscale scores for flattened affect, anhedonia, avolition/anergia, social withdrawal, alogia, and attentional deficits. Table 9.1 shows the bivariate correlations of the anhedonia measures with the interview ratings of negative symptoms.

Table 9.1 Correlations of questionnaire measures of anhedonia with interview ratings of negative symptoms (n=430)

Negative symptom manual rating	Physical anhedonia	Social anhedonia	Combined anhedonia
Total score	.35*	.53*	.52*
Avolition/anergia	.21*	.30*	.30*
Attentional deficits	.11	.30*	.24*
Social withdrawal	.25*	.53*	.45*
Alogia	.19*	.29*	.28*
Flattened affect	.32*	.37*	.41*
Anhedonia	.31*	.35*	.39*

Medium effect sizes in bold, large effect sizes in bold and italics

* $p < .001$

Consistent with the characterization of anhedonia playing a central role in negative schizotypy, the physical, social, and combined anhedonia ratings had moderate to large associations with the overall interview rating of negative symptoms and with the anhedonia and flattened affect components. Not surprisingly, social anhedonia had especially elevated associations with the social withdrawal rating, but was also moderately associated with the cognitive deficit components of negative symptoms. Note that the interview rating of anhedonia was significantly correlated with the other five classes of negative symptoms with large effects for the associations with social withdrawal and flattened affect. Overall, the results are especially striking because they were found in a non-clinical sample of young adults.

9.7.2 Longitudinal Assessment of Schizotypic Anhedonia

The previously reviewed studies typically examined anhedonia within schizotypy and schizophrenia at cross-sectional assessments. However, longitudinal study is ultimately needed to examine the expression and role of anhedonia in the etiology and development of schizophrenia-spectrum psychopathology. Longitudinal studies are difficult to conduct because of the lengthy time investment and the cost and challenges associated with follow-up visits. Nonetheless, longitudinal research can yield direct information about risk factors and clinical prognosis, which can inform clinical prevention. Several psychometric high-risk studies have examined the predictive validity of anhedonia.

Chapman et al. [22] conducted a 10-year longitudinal study of 534 young adults identified by high scores on their schizotypy or psychosis screening scales. They used a high-risk groups approach in which extreme scorers on the scales were compared with a control group of low scoring participants. They indicated that physical anhedonia did not predict the development of schizophrenia or spectrum disorders at the 10-year follow-up. However, a combined magical ideation-social anhedonia group was found to be at particular heightened risk, with 21 % transitioning to psychotic disorders at the 10-year reassessment.

Kwapil et al. [92] replicated the deviance of this combined positive and negative schizotypy group in an independent longitudinal sample. Kwapil [38] examined the predictive validity of the Revised Social Anhedonia Scale partialling out the effects of positive schizotypy measures using the Chapmans' 10-year follow-up data. In this sample, 24 % of individuals with elevated social anhedonia reported schizophrenia-spectrum disorders at the 10-year follow-up compared to only 1 % of controls. Additionally, social anhedonia predicted elevated rates of psychotic-like, schizotypal, schizoid, and paranoid symptoms and poor functioning in the participants who had not transitioned into schizophrenia-spectrum disorders, indicating that the schizotypic features were not simply limited to the individuals who developed other schizophrenia-spectrum disorders.

However, the strongest support for the predictive validity of the physical and social anhedonia comes from a recent reanalysis of the Chapmans' longitudinal data [93]. They found that a combined dimensional rating of negative symptoms based upon scores on the Physical and Revised Social Anhedonia Scale significantly predicted schizophrenia-spectrum disorders at the 10-year follow-up over-and-above positive schizotypy and provided better prediction than group membership based upon the individual anhedonia scales. Furthermore, anhedonia was also associated with schizophrenia-spectrum symptoms and impairment in individuals who had not developed clinical disorders at the 10-year follow-up, consistent with a continuum model of schizotypy.

Gooding and colleagues also replicated these longitudinal findings. Gooding et al. [37] reported that 15 % of a group of high scorers on the Revised Social Anhedonia Scale developed schizophrenia-spectrum disorders at a 5-year reassessment compared to only 3 % of a positive schizotypy group and none of the control participants. Gooding et al. [94] reanalyzed this data and reported that the rate of spectrum disorders in the anhedonia group increased to 19 % when avoidant personality disorder was included in the definition of spectrum conditions.

These findings have been corroborated by a recent longitudinal study with an ultra high-risk group, showing social anhedonia and withdrawal at baseline predicted transition to psychosis at a 3-year follow-up [78]. On the other hand, a 1-year follow-up study with an ultra high-risk sample showed that, while a composite of 6 negative symptoms predicted transition to psychosis, none of the negative symptoms alone—anhedonia included—were predictive of conversion [77]. In a study following an at-risk prodromal group, half of participants developed a psychotic disorder 1 year later. Exploratory analyses indicated that marked social isolation was one of the prodromal symptoms found to predict conversion to psychosis [95].

Our laboratory conducted a 2.5-year longitudinal reassessment of 74 female and 28 male college students who were oversampled for physical and social anhedonia. The participants had a mean age of 19.4 years ($SD=2.8$) at the initial assessment and 22.0 years ($SD=2.9$) at the follow-up assessment. Participants completed the Physical and Revised Social Anhedonia Scales in mass screening sessions and underwent structured diagnostic interviews assessing schizophrenia-spectrum psychopathology, mood disorders, substance abuse, and impairment at the time of selection and at the follow-up assessment. Table 9.2 presents the correlations and

Table 9.2 Correlations and logistic regressions of measures at the initial and follow-up assessment (n = 102)

Dependent variable	Initial assessment anhedonia		Follow-up assessment anhedonia	
	<i>r</i>		<i>r</i>	
Global assessment of functioning	-.55***		-.42***	
Psychotic-like experiences	.26**		.27**	
Negative symptom manual	.55***		.55***	
Schizotypal personality rating	.46***		.32**	
Schizoid personality rating	.53***		.51***	
Paranoid personality rating	.29**		.25*	
Impairment from alcohol use	-.04		.00	
Impairment from drug use	.03		-.11	

Dependent variable	Anhedonia		Anhedonia	
	Odds ratio	95 % CI	Odds ratio	95 % CI
Any schizophrenia-spectrum disorder	1.00	0.99–1.01	1.99	1.00–4.00
Any mental health treatment	1.12	0.78–1.60	1.26	0.93–1.71
Major depressive episode	0.88	0.68–1.58	1.02	0.74–1.41

Medium effect sizes in bold, large effect sizes in bold and italics (correlations only)

p* < .05; *p* < .01; ****p* < .001

binary logistic regressions of anhedonia predicting interview ratings of functioning and psychopathology at the initial and follow-up assessments. As hypothesized, anhedonia significantly predicted impaired functioning and schizophrenia-spectrum symptoms at both assessments, but was unassociated with ratings of substance use or diagnoses of major depressive disorder. Strikingly, psychometrically assessed schizotypic anhedonia was cross-sectionally and longitudinally associated with interview ratings of negative and schizoid symptoms, but not with depressive disorders—nicely highlighting the differences between schizotypic and depressive anhedonia. Not surprisingly, rates of schizophrenia-spectrum disorders were low, consistent with the use of a college student sample. One participant met criteria for schizoid personality disorder at the initial assessment (as well as at the follow-up assessment). This participant had a combined physical and social anhedonia scale score at the time of selection that was five standard deviations above the mean. At the follow-up assessment, two other participants had developed psychotic disorders. However, the prediction of spectrum disorders at the follow-up by anhedonia fell short of statistical significance, *p* = .051. Anhedonia did not significantly predict the number of participants receiving any psychological treatment at either assessment. However, it did predict the number of new treatment cases at the follow-up, OR = 1.51 (95 % CI = 1.01–2.26), *p* < .05.

In sum, longitudinal data show that schizotypic anhedonia is predictive of the development of schizophrenia-spectrum disorders and symptoms. Given that anhedonia is defined as a component of negative schizotypy, the presence of social

and physical anhedonia in late adolescence or early adulthood represents early signs of schizotypic psychopathology and impairment and for some participants may represent early manifestations of the schizophrenia prodrome. Thus, it is not entirely surprising, but nonetheless important to demonstrate, that anhedonia predicts subsequent development of schizophrenia-spectrum disorders. Given this basic demonstration of the construct validity of schizotypic anhedonia, it will be essential to identify factors that exacerbate this risk and increase the likelihood of transitioning into schizophrenia-spectrum disorders, and protective factors that may dampen this risk. Note that consideration of the multidimensionality of schizotypy is essential for targeting risk factors. For example, cannabis is frequently cited as a risk factor for transition into psychosis (e.g., [96]). However, our findings repeatedly indicate that participants with negative schizotypy (characterized primarily by anhedonia) are not at elevated risk for using cannabis (and may in fact be at lower risk—especially in comparison to their positive schizotypy peers). This does not mean that we should not encourage participants with negative schizotypy to avoid cannabis, but rather that this may not be as important of a risk pathway as in positive schizotypy. We suggest that the compounding consequences of social withdrawal and the loss of the protective factors provided by healthy social relationships may be especially worth examining.

9.8 Assessing Anhedonia in Daily Life

Traditional laboratory and self-report studies provide important information about anhedonia and its role in schizophrenia-spectrum psychopathology. However, these studies often are unable to inform us about the experience and expression of anhedonia in daily life. Self-report or interview assessments typically inquire about general recollections across weeks or months regarding symptoms and impairment. However, these questions are subject to recall biases and may be influenced by the artificial setting of the study. Recent investigations have employed ESM to examine anhedonia in daily life. ESM is a within-day self-assessment technique in which participants are prompted at random intervals to complete brief questionnaires. ESM offers several advantages to traditional assessment procedures. Specifically, ESM: (1) repeatedly assesses participants in their normal daily environment, enhancing ecological validity; (2) assesses participants' experiences at the time of the signal, minimizing retrospective bias; and (3) allows for examination of the context of participants' experiences. Thus, this method provides a unique window for examining the real-world expression of anhedonia.

Our research group has conducted four ESM studies examining the expression of anhedonia in daily life. The first two studies, Brown et al. [34] and Kwapil et al. [33] were limited to the study of social anhedonia. However, Kwapil et al. [97] and Barrantes-Vidal et al. [98] examined the expression of our composite rating of physical and social anhedonia (negative schizotypy) and positive schizotypy in daily life. Kwapil et al. [97] examined the expression of anhedonia in the daily life of 412 undergraduate students. Participants were issued personal digital assistants that

signaled them eight times daily for 1 week to complete brief questionnaires regarding affect, thoughts, activities, and social contact. They completed an average of 42 questionnaires during the weeklong assessment. As hypothesized, anhedonia was associated with daily life reports of diminished positive affect, less pleasure from important events, and less time spent with others. Anhedonia was associated with greater social distance and greater preference to be alone when with others, and a diminished desire to be with others when alone. Finally, anhedonia was associated with diminished enjoyment of current activities. Thus anhedonia is characterized by a pattern of diminished pleasure from social and non-social activities, decreased social contact, and preference to be alone. Furthermore, the pattern of findings in daily life for anhedonia/negative symptoms was in sharp contrast to positive schizotypy, which was associated with affective dysregulation, social anxiety, and suspiciousness.

Barrantes-Vidal et al. [98] extended the work of Kwapil et al. [97] by examining the association of anhedonia with psychotic-like, paranoid, and negative symptoms in daily life in a sample of 206 Spanish college students who completed an average of 41 ESM questionnaires during the week. They reported that anhedonia was associated with diminished positive affect and positive appraisals of the current situation and current activities, but not with elevated negative affect or appraisals. They replicated Kwapil et al.'s [97] findings that anhedonia was associated with diminished social contact, interest, and closeness. Most striking, they found that anhedonia was associated with the negative symptom of reporting “no thoughts or emotions” in the moment and with the momentary experience of psychotic-like experiences. Furthermore, social stress in the moment was associated with increased psychotic-like symptoms for high anhedonic participants.

Converging evidence from various assessment methods and domains of research shows that anhedonia is present across the entire schizotypic continuum. Though recent data reveals that its underpinnings may be cognitive-behavioral in nature, as well as reflecting an experiential deficit in pleasure, anhedonia is nevertheless present in a range of individuals and associated with adverse outcomes. Cross-sectional studies have shown social and physical anhedonia to be linked with low positive affect and poor social, familial, and global functioning. Longitudinal studies have shown that social anhedonia greatly increases the risk of developing schizophrenia-spectrum disorders and symptoms across time. Recent improvements in assessment methods, such as new interview measures that distinguish between anticipatory and consummatory pleasure, have increased our knowledge about the expression of anhedonia. Cross-sectional studies simultaneously comparing groups along the schizotypic continuum, as well as additional longitudinal studies, could provide more precise information about the developmental course of anhedonia.

9.9 Conclusions and Future Directions

Ample evidence suggests that “some patients” with schizophrenia exhibit “some degree” of “some types” of anhedonia. Furthermore, anhedonia also seems to characterize the broader phenotype of schizotypy, albeit with the same provisos

and guarded language. We believe that anhedonia provides a useful example of the heterogeneity of schizotypy and schizophrenia and why we must consider, understand, and operationalize the underlying multidimensional structure of schizotypy if we are going to make headway in understanding etiology and developing effective treatments and prophylactic interventions. In fact, we would argue that anhedonia is a core deficit of the negative symptom dimension of schizotypy. Furthermore, it appears that this dimension is associated with unique underlying pathophysiology, symptoms, impairment, and treatment response. Studies that fail to consider this multidimensional structure risk producing misleading, uninterpretable, or irreproducible results. For example, studies that ask broad questions such as, is schizotypy [broadly defined] associated with substance abuse or openness to experience could find significant direct or inverse relationships, or no relationship at all, simply dependent upon the “flavor of schizotypy” in their sample. For example, we have found that positive schizotypy is strongly associated with substance use and with elevated openness. Our dimension of negative/anhedonic schizotypy is associated with low openness and sensation seeking, and usually unassociated with substance use.

Thus future study of the role of anhedonia in schizotypy and schizophrenia should consider careful operationalization, rigorous assessment, differentiation of schizotypic anhedonia from other pathological conditions and normal individual differences, and perhaps most importantly, understanding of processes and mechanisms underlying anhedonia and the larger heterogeneity of schizotypy and schizophrenia. Undoubtedly, elucidating underlying processes will involve genetic, neuroanatomical, and neurotransmitter mechanisms across a complex pattern of development. However, we also strongly urge consideration of environmental factors, especially early interpersonal factors such as trauma and attachment in considering the development of both social and non-social anhedonia. Along with considering the environmental factors contributing to the development of anhedonia, studies should consider how anhedonia plays out in the environment across the schizophrenia spectrum. This is especially concerning for nonclinical individuals with prominent social anhedonia who may avoid early detection and lose the benefits of a nurturing social environment. The anticipatory and consummatory pleasure distinction appears especially promising. However, we expect that the answer is not a simple either-or, but that different processes underlie these deficits and that there is considerable individual differences among patients regarding the degree to which they exhibit deficits in the anticipation of pleasure and the immediate experience of pleasure. Furthermore, it is important to keep in mind that depression is highly comorbid with schizophrenia-spectrum disorders and subclinical schizotypy and contributes another pathway to diminished pleasure that may further “muddy” the search for specific etiological pathways.

Finally, we believe that there are exciting prospects for novel assessments of anhedonia in schizotypy and schizophrenia. Self-report and interview-based assessments of anhedonia in schizotypy have been extensively developed. Based on the large literature using these tools reviewed here and elsewhere [7], self-report scales for assessing physical and social anhedonia have substantial evidence

for reliability and validity. The next step, then, is to develop innovative ways of capturing the expression of negative schizotypy that move beyond self-reports and structured interviews.

ESM strikes us as particularly promising for providing a detailed, nuanced look at what anhedonia, and more broadly negative schizotypy, looks like in everyday life. This chapter has reviewed work on the daily expression of anhedonia, and these studies have supported our description of the construct. So far, however, experience sampling work has only scratched the surface of the possibilities for daily-life assessment. For example, as of yet there are no event-contingent designs, which ask people to complete a survey when an event occurs, such as social interactions, pleasant and unpleasant experiences, and unusual thoughts. Such methods would afford highly detailed assessments of particular events of interest when they happen. In addition, it would be worthwhile to use extended sampling periods, such as one or more months, to examine trends in functioning over extended periods of time, rather than sampling a single typical week.

Another direction in assessment concerns the use of physiological methods. In our recent work, we have become interested in tools from autonomic psychophysiology for indexing how much effort people expend as they strive to achieve goals and incentives (e.g., [99, 100]). A large literature in the basic science of effort has established sympathetic and parasympathetic markers of engagement in the pursuit of rewards [101, 102], with a particular emphasis on measures of cardiac activity. This literature can thus be translated to the problem of negative schizotypy to yield physiological indicators of when people are trying harder to reach a goal versus withdrawing effort and failing to engage.

A final intriguing direction combines the self-report assessments found in conventional experience sampling with the physiological information gained by cardiac autonomic assessment. Advances in ambulatory physiological monitoring enable researchers to assess cardiac functioning as people go about their normal days [103]. By combining self-reports and physiological assessment, researchers can examine how biological markers of stress, motivation, and engagement change as people encounter the naturalistic goals and challenges in their normal environments. Such methods are on the frontier of schizotypy research, and they promise a new level of insight into how both biological and psychological aspects of anhedonia are expressed in everyday life.

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