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Trait and State Affective Experience Among High-Risk People in the Schizophrenia Spectrum: A Meta-Analytic Review

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Evidence suggests that individuals with schizophrenia display a trait–state disjunction in affective experience characterized by severe trait-level disturbances yet relatively intact state-level experiences, but the extent to which trait–state disjunction is found in individuals at high risk (HR) for schizophrenia-spectrum disorders is unclear. Therefore, this meta-analysis provides an integrative evaluation of HR individuals' self-reported affective experiences across trait and state to identify which disturbances are most pronounced and for whom—a crucial objective for understanding affective vulnerability factors for schizophrenia. A literature search yielded 181 studies, totaling 995 effect sizes across 9,672 HR and 15,386 controls. Notably, a large amount of heterogeneity among effect sizes was observed. Multivariate models with robust variance estimation showed that HR (vs. control) participants had lower trait positive affect (PA) and higher trait negative affect (NA), with state-level disturbances being weaker than trait-level disturbances. Heightened NA generalized across methods used for eliciting and assessing affective experiences, whereas PA deficits were more variable and most severe for social processes. Moreover, the severity of PA and NA disturbances was greater for participants with higher levels of schizophrenia-spectrum risk. Overall, findings provide support for the trait–state disjunction in HR conditions along the schizophrenia spectrum, although the observed heterogeneity highlights the uncertainty of our findings and urges continued investigation in further explicating this heterogeneity. We outline an explanatory model for these findings and discuss important implications to facilitate future research on the role affective experience disturbances may play in the developmental pathway for schizophrenia.

Public Significance Statement

This systematic review and meta-analysis reveal that individuals at high risk for schizophrenia-spectrum disorders self-report robustly heightened negative affect and nuanced positive affect deficits across trait and state. Trait-level disturbances were more pronounced compared to state-level disturbances, thereby demonstrating a trait–state disjunction in high-risk individuals similar to that of individuals with schizophrenia. Therefore, disturbances in affective experience may be considered a vulnerability factor for schizophrenia.

Keywords: schizophrenia, risk, affective experience, self-report, trait–state disjunction

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There is a clear consensus that disturbances in affective experience are an integral component of schizophrenia-spectrum pathology. Over a century ago, preeminent thinkers in psychopathology considered symptoms such as flat affect and ambivalence—the simultaneous experience of contradictory feelings and thoughts—cardinal to schizophrenia (Bleuler, 1911/1950; Kraepelin, 1919/1971). Modern conceptualizations of schizophrenia continue to place disturbed affective experiences at the heart of symptom constellations. For example, the most recent edition of the *Diagnostic and Statistical Manual of Mental Disorders* (*DSM-5*) includes anhedonia, or the diminished experience of pleasure, as a key diagnostic feature for schizophrenia (American Psychiatric Association, 2013). Not only crucial for understanding symptom presentation, affective experience disturbances detrimentally impact many life domains (Blanchard et al., 1998; Horan et al., 2008; Kotov et al., 2016) and are refractory to available treatments (Correll &

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Schooler, 2020) among those with a schizophrenia-spectrum disorder. Despite great clinical and public health significance, our understanding of these affective experience disturbances is fraught with conflicting findings.

Perhaps the most perplexing phenomenon is that of a discrepancy between trait-level and state-level self-reported experiences, or a trait–state disjunction. Largely in line with the historical characterizations, individuals with schizophrenia consistently report lower levels of trait positive affect (PA) and higher levels of trait negative affect (NA) compared to healthy controls (Horan et al., 2006, 2008). In contrast, state-level experiences in response to affective stimuli are generally similar between those with schizophrenia and controls (Cohen et al., 2011; Kring & Elis, 2013). A meta-analysis of these studies supported patients' largely intact capacity to experience stimulus-congruent emotional states, showing a small and statistically nonsignificant difference in PA after pleasant stimuli and in NA after unpleasant stimuli compared to controls (Cohen & Minor, 2010). Interestingly, patients with schizophrenia reported a heightened NA of large magnitude after both pleasant and neutral stimuli. This stimulus-incongruent NA is in line with the notion of ambivalence and, together with the trait findings, reflects a deficit in inhibiting NA when it is uncalled for (Cohen et al., 2011; Cohen & Minor, 2010). Thus, understanding the trait–state disjunction has provided critical insights on the nature of affective experience disturbances in schizophrenia, which paves the way for developing targeted treatment strategies (e.g., emotion regulation training).

While this literature paints a clearer picture of affective experience disturbances in schizophrenia, the extent to which trait–state disjunction is found in less severe conditions along the schizophrenia spectrum remains unclear. Specifically, the lower end of this spectrum is indicated by a constellation of maladaptive personality traits and subthreshold symptoms that share the etiology for schizophrenia (Kotov et al., 2020; Kwapil & Barrantes-Vidal, 2015). Individuals with these traits and symptoms are considered at high risk (HR) for developing more severe forms of the spectrum pathology, such as schizophrenia. Increasingly, the affective experience of those at HR has become a research focus. Similar to schizophrenia, many studies have revealed low trait PA and high trait NA in HR individuals (Gooding & Pflum, 2014; Horan et al., 2008; Li, Fung, et al., 2019). However, a sizable number of studies did not find such trait disturbances (e.g., Craver & Pogue-Geile, 1999; Laurent et al., 2000; Salisbury et al., 1996; Yan et al., 2016; Yee & Miller, 1994). Results are even more mixed for state-level experiences. Whereas some studies observed a significant impairment similar to, or even more severe than, that of individuals with schizophrenia (e.g., Cohen et al., 2012; Kerns, 2005; Kerns et al., 2008), others called into question the presence of state-level affective experience disturbances among HR individuals (e.g., Cohen et al., 2016; Fung et al., 2017; Modinos et al., 2010).

Integrating previous research to elucidate the magnitude and moderators of affective experience disturbances in HR individuals is of timely importance for theory, research, and clinical practice. Uncovering which affective experience disturbances are most pronounced, and for whom, is essential to identify specific affective vulnerability markers while also clarifying the continuities and discontinuities in the developmental trajectory of schizophrenia. Therefore, the objective of this meta-analysis was to integrate previous research on self-reported trait and state affective experiences among HR individuals in the schizophrenia spectrum prior to the manifestation of full-blown psychosis. To clarify this empirical picture, six factors hypothesized to impact the magnitude of affective experience disturbances in HR individuals are discussed next and tested as moderators in the meta-analysis.

Trait Versus State Affective Experiences

As previously discussed, affective experiences can be primarily categorized into trait and state levels. While both trait and state experiences are constructed based on episodic knowledge (i.e., loosely organized contextual details) and semantic knowledge (i.e., tightly organized beliefs about the situation or the self), they differ in the extent to which these two sources of self-knowledge are accessed (Robinson & Clore, 2002a). State-level ratings made immediately or shortly after an event (e.g., "right now") primarily draw from episodic knowledge. In contrast, because of the difficulty in accessing and integrating episodic details, trait-level ratings (e.g., "in general") primarily tap into semantic knowledge (Robinson & Clore, 2002b, 2002a). Given the long tradition of research linking dysfunctional beliefs to the schizophrenia spectrum (Beck et al., 2009; Beck & Rector, 2005), as well as the established trait–state disjunction in schizophrenia, we hypothesized that HR individuals' trait-level disturbances would be more severe than state-level disturbances.

Negative Versus Positive Affect

Among the dysfunctional beliefs, the negative self-referential bias is particularly striking and has been associated with reduced perceived functional outcomes in both affected and HR populations (Campellone et al., 2016; Fervaha et al., 2015; Grant & Beck, 2009; Luther et al., 2016; Perivoliotis et al., 2009). Correspondingly, narrative reviews on trait and state affective experiences consistently identified heightened NA as a core feature of HR individuals (Horan et al., 2008; Phillips & Seidman, 2008). PA deficits, however, appear less consistent across studies (Horan et al., 2008; Phillips & Seidman, 2008). As such, some theorists proposed that deficient PA might be a consequence of heightened NA lowering the net hedonic value rather than an inability to experience PA (Cohen et al., 2011; Strauss, 2013). Therefore, we hypothesized that among HR individuals, disturbances in NA would be more severe than disturbances in PA across trait and state.

Unipolar Versus Bipolar Scales

State affective experiences have been commonly measured using two types of self-report scales, namely unipolar versus bipolar scales. These two scale types are based on fundamentally distinct models of affective structure that are subject to tremendous debate (e.g., Cacioppo & Berntson, 1994; Diener & Emmons, 1984; Russell, 1980; Russell & Carroll, 1999; Watson & Tellegen, 1985). Unipolar scales measure PA and NA separately, where participants are typically asked to rate the intensity of each emotion word (e.g., rate the extent to which "happy" is experienced from "not at all" to "extremely"; Watson et al., 1988). They are based on the conceptualization that experiences of positivity and negativity are independent (e.g., the evaluative space model; Cacioppo & Berntson, 1994). Conversely, bipolar scales place PA and NA on the opposing end of a single continuum (e.g., Self-Assessment Manikin

Scale; Bradley & Lang, 1994). They are based on the conceptualization that experiences of positivity and negativity are mutually exclusive (e.g., the valence-arousal model; Russell, 1980). Critically, bipolar scales do not allow for the co-occurrence of PA and NA, which may mask the true affective experience disturbances in HR individuals given their tendency to simultaneously experience contradictory emotions. Therefore, we hypothesized that the use of bipolar scales would result in attenuated state disturbances compared to that of unipolar scales.

Trait Affective Experience Types

A diverse range of trait affective experience types has been studied in HR individuals, such as affective personality traits (e.g., neuroticism and extraversion) and temperaments (e.g., novelty seeking, reward dependence, and harm avoidance), the tendency to experience pleasure or lack thereof (i.e., anhedonia), and general mood. There are indications that trait PA deficits are sensitive to the type of experience assessed, with evidence being the weakest for PA-related temperaments (e.g., novelty-seeking reward dependence) and the strongest for anhedonia (Horan et al., 2008; Phillips & Seidman, 2008). Particularly, past theorizing suggests that anhedonia as a marker for schizophrenia liability is chiefly social in nature (Meehl, 1962, 1990). In accordance with this perspective, longitudinal work demonstrates that social anhedonia is a superior predictor of future schizophrenia-spectrum disorders than physical anhedonia (Chapman et al., 1994; Kwapil, 1998). Therefore, we hypothesized that pleasure experiences within the social domain would show the greatest deficit than all other types of trait PA for HR individuals.

Trait NA, however, appears to be broadly heightened across experience types. There is some evidence that NA-related temperaments, such as harm avoidance, are least disrupted in HR individuals (Horan et al., 2008). On the other hand, symptoms of anxiety and depression are prevalent among HR individuals, suggesting that anxiety- and depression-related mood disturbances might be most pronounced (Phillips & Seidman, 2008; van Os, 2013; van Os & Reininghaus, 2016). However, anxiety and depressive symptoms might also result from high neuroticism, which is commonly observed in those at HR (Horan et al., 2008). Thus, although there are some nuances in different types of trait NA disturbances, HR individuals are primarily characterized by a broadly heightened trait NA. Therefore, we hypothesized that different experience types would not produce demonstrable differences in trait NA severity for HR individuals.

State Affective Experience Procedures

In addition to distinct scale types, several other methods used to elicit and assess state affective experiences differ considerably across studies. Baseline states have been studied either as a one-time assessment in the lab or as repeated assessments in daily life using experience sampling methods. Additionally, induced states have been elicited by different types of stimulus (e.g., pictures, faces, films, and odors) and rated in reference to the self (e.g., "How pleasant do you feel in response to the stimulus?") or the stimulus (e.g., "How pleasant is the stimulus?"). These variations in procedures have been noted as a potential source of conflicting findings (Kring & Elis, 2013). For example, in contrast to patients' relatively preserved capacity to experience stimulus-congruent emotional states, one meta-analysis on daily life emotional experiences of patients with schizophrenia (vs. controls) found lower PA and higher NA of large magnitude (Cho et al., 2017). However, unlike induced states that are in response to emotion-eliciting stimuli, daily emotional experiences are not tied to specific events. It is therefore unclear whether the differences in findings are due to different assessment procedures or the difference between induced versus baseline states, and there is currently no systematic research comparing laboratory and daily assessments of baseline states. With respect to types of elicitation and assessment procedures for induced states, one meta-analysis of patients with schizophrenia did not observe a statistically significant moderation by the type of induction stimulus or rating reference (Cohen & Minor, 2010). However, these analyses may be underpowered due to the small number of studies included in the moderator categories. Further, results for these analyses on patients may not necessarily apply to those at HR, as there is evidence suggesting important discontinuities between affected and HR individuals in state affective experiences (Cohen et al., 2012; Strauss & Cohen, 2018). To explore how the aforementioned procedure types may impact state affective experience disturbances in HR individuals, we tested them as separate moderators.

High-Risk Approaches

In addition to the diversity in eliciting and assessing affective experiences, studies have also relied on different approaches to identify HR individuals that broadly fall into familial HR (FHR), HR trait, and clinical HR (CHR) state. The FHR approach involves biological first-degree relatives of individuals with schizophrenia or schizoaffective disorder regardless of their symptom presentation. The HR trait approach identifies individuals with elevated schizotypal personality traits, which are similar to symptoms of schizophrenia but in an attenuated form (e.g., social anhedonia, perceptual aberration, and magical ideation). This approach predominately involves the use of psychometric measures, such as the Schizotypal Personality Questionnaire (Raine, 1991) and the Wisconsin Schizotypy Scales (Chapman et al., 1978; Eckblad & Chapman, 1983; Eckblad et al., 1982). Individuals whose responses are considerably elevated (e.g., greater than 1.96 standard deviation above the mean) are thereby included in the HR group, typically referred to as psychometric HR. Relatedly, individuals who meet the threshold for a personality disorder (PD) as determined by clinical interviews also belong to the HR trait approach, including schizotypal, paranoid, and schizoid PDs that are collectively subsumed under Cluster A PD in the DSM (American Psychiatric Association, 2013). Last, the CHR approach (also known as "at-risk mental state," "prodromal," and "ultra-high-risk"; Fusar-Poli et al., 2013) involves help-seeking individuals presenting psychotic-like experiences who are believed to be at incipient risk for psychosis. This approach typically involves the use of clinical interviews, such as the Structured Interview for Prodromal Syndromes (Miller et al., 2003). Individuals identified under all three approaches have been found to exhibit a higher rate of conversion to psychosis: compared to the 1% prevalence rate of schizophrenia in the general population (American Psychiatric Association, 2013), 6%–13% of FHR (Phillips & Seidman, 2008), 5%–25% of HR trait (Asarnow, 2005; Chapman et al., 1994; Fenton & McGlashan, 1989; Kwapil, 1998; Lenzenweger, 2021), and 22%–36% of CHR individuals (Fusar-Poli et al., 2013) will transition to a psychotic disorder during their lifetime.

These three approaches are somewhat overlapping yet largely complementary. For instance, there is a large degree of phenomenological overlap between CHR and HR trait criteria. Cicero et al. (2014) found that 77% of individuals identified as psychometric HR also showed clinically meaningful psychotic-like experiences, a criterion for CHR. Nevertheless, these two approaches notably differ in their trait versus state characteristics of risk. Whereas the HR trait approach emphasizes stable personality traits, the CHR approach requires a relatively short onset and/or worsening function (i.e., HR state; Debbané et al., 2015). At the same time, trait and state characteristics have been found to interact, with their coexistence associated with the greatest rate of conversion to psychosis (Debbané et al., 2015). Overall, these three approaches seem to represent a gradient of schizophrenia-spectrum risk with FHR being the lowest followed by HR trait, and CHR being the highest. Therefore, we tested whether the severity of affective experience disturbances would be associated with the degree of schizophrenia-spectrum risk. Specifically, we hypothesized that FHR would be associated with the least severe affective experience disturbances followed by HR trait (psychometric HR and Cluster A PD), and that CHR would be associated with the most severe disturbances.

The heterogeneity of schizophrenia-spectrum risk is not only apparent in terms of symptom severity. Mounting research suggests that this risk is also characterized by a multidimensional factor structure. Although multiple factors have been proposed, studies typically support a three-factor model consisting of a positive dimension (i.e., sensory and cognitive abnormalities), a negative dimension (i.e., diminished experiences in emotion and behavior), and a disorganized dimension (i.e., disorganized thinking, speech, and behavior) that mirrors the symptoms of schizophrenia (Kwapil & Barrantes-Vidal, 2015). These three dimensions are characterized by unique symptom presentations, with positive and negative dimensions being largely independent, whereas the disorganized dimension shows moderate associations with the other two dimensions (Christensen et al., 2019; Kerns, 2006; Li et al., 2020). Additional evidence points to distinct etiology, developmental trajectory, and treatment responses between positive and negative dimensions (Barrantes-Vidal et al., 2013; Chapman et al., 1994; Kwapil, 1998; Sarkar et al., 2015). Given these considerations, it appears important to separate these dimensions when examining affective experience disturbances in HR individuals.

Indeed, there is some evidence supporting differential associations between symptom dimensions and affective experience disturbances, with this work primarily relying on the psychometric HR approach. For instance, whereas individuals scoring high on the positive or the negative dimension both display high trait NA, only those scoring high on the negative dimension display low trait PA (Gooding & Pflum, 2014; Gooding & Tallent, 2003; Horan et al., 2008; Li, Fung, et al., 2019). While studies examining the disorganized dimension have been scant, there is initial evidence for it being associated with heightened trait affect intensity (both PA and NA) and ambivalence (Kerns, 2006; Kerns & Becker, 2008; Loas et al., 2014). Therefore, when examining the association between HR approach and affective experience disturbances, we separated the psychometric HR group by the defining symptom dimension. That is, positive, negative, disorganized, or total when two or more dimensions were used to identify HR individuals. We hypothesized that high NA would be associated with all symptom dimensions, whereas low and high PA would be associated with the negative and disorganized dimensions, respectively.

Overview of the Current Meta-Analysis

This meta-analysis aimed to comprehensively and systematically integrate previous research on trait and state affective experiences across HR conditions in the schizophrenia spectrum. Studies that compared participants fulfilling the criteria of FHR, HR trait (psychometric HR or Cluster A PD), or CHR to control participants on self-reported affective experiences were reviewed. Possible moderators pertaining to the elicitation/assessment of affective experiences and HR approaches were investigated. To our knowledge, this meta-analysis represents the largest undertaking to synthesize affective experiences in HR individuals. Findings promise to provide novel insights on the affective factors most relevant for understanding the etiology and development of schizophrenia.

Method

Inclusion and Exclusion Criteria

The current meta-analysis aimed to include all studies, published or unpublished, that reported at least one cross-sectional comparison of HR and control individuals on self-reported affective experience, regardless of their specific aims. A study had to satisfy the following three criteria in order to be included. First, participants must meet at least one of the three HR definitions as described above (i.e., FHR, HR trait, and CHR) without meeting the criteria for a diagnosis of schizophrenia or schizoaffective disorder. Specifically, with the exception of FHR, risk had to be assessed using well-validated self-report and/or interview measures with specific criteria to define the HR group. In the case of psychometric HR, studies have employed a variety of HR cutoffs, such as mean/standard deviation, percentage of the sample, and cluster analysis. We followed the study's psychometric HR criterion, but, if raw data set was available, redefined the HR group as those scoring in the top 10% of the sample based on current prevalence estimates (Linscott & van Os, 2013; Meehl, 1990; Nuevo et al., 2012).[1]

Second, an appropriate control group must be included, defined as individuals scoring low on self-report screening measures and/or free of any clinically significant psychotic-like experiences based on interviews, and thus at low risk for developing schizophrenia-spectrum disorders. Given that studies vary in their screening and reporting of nonpsychotic symptoms and considering the recent push to avoid a "super normal" control group so as to enhance the specificity to schizophrenia-spectrum pathology (Millman et al., 2019; Schwartz & Susser, 2011), we did not require control participants to be free of nonpsychotic symptoms. The control group also did not need to be matched with the HR group on demographic characteristics, as we planned to empirically test the impact of nonmatched samples.

Third, an appropriate self-report measure of affective experience must be included. Affective experience was broadly defined to include multiple types of valenced processes, such as affective personality traits, pleasure, anhedonia, and discrete emotional states. However, scales that measured symptoms specifically related to a clinical disorder (most commonly, depression and anxiety) were deemed inappropriate because they captured experiences beyond the

[1] Only five studies (2.76%) involved redefined HR groups. Results remained unchanged with these five studies excluded.

scope of affect (e.g., suicidal thoughts and biased beliefs). Although these scales included items measuring affective experiences (e.g., anhedonia), responses on relevant items were rarely reported in isolation. In a similar vein, anhedonia was examined for all HR approaches except psychometric HR because the same anhedonia measures were frequently used to identify the psychometric HR group. An affective experience was considered to be trait-level when participants were asked to indicate their feelings generally or, if a time frame was specified, more than 2 weeks into the past. This 2-week cutoff was based on findings by Robinson and Clore (2002b), showing that people switched from an episodic retrieval strategy to a semantic one for time frames longer than a few weeks. Conversely, an affective experience was considered to be state level when participants were asked to indicate their feelings at the moment.

Literature Search

Four complementary search strategies were adopted to ensure comprehensive coverage of the relevant literature. First, electronic databases were searched in July 2018 and July 2020, namely PsycINFO, ProQuest Dissertations & Theses A&I, and MEDLINE. Keyword search terms were derived from published review protocols on schizophrenia-spectrum risk (e.g., PROSPERO record ID: CRD42017077470), supplemented with terms relevant to trait and state affective experience based on two reviews (Cohen & Minor, 2010; Horan et al., 2008). In addition, search terms were tailored in consultation with a library specialist to maximize coverage. The complete set of terms was used to search the abstract of reports in the databases and involved every combination of HR approach and trait/state affective experience across conceptual and methodological domains (see Supplemental Materials). Taken together, online database search yielded 7,330 reports.

Second, a descendant search was conducted where any reports that cited prominent reviews on trait and state affective experiences in schizophrenia and/or schizophrenia-spectrum risk were searched using Web of Science Citation Indexes in July 2020 (Cho et al., 2017; Cohen et al., 2011, 2015; Cohen & Minor, 2010; Horan et al., 2008; Kohler & Martin, 2006; Kring & Elis, 2013; Kring & Moran, 2008; Phillips & Seidman, 2008; Strauss, 2013; Strauss & Gold, 2012; Trémeau, 2006; Yan et al., 2012). This strategy yielded 1,617 reports.

Third, the References section of reviews on affect processing in schizophrenia-spectrum risk (Cohen et al., 2015; Horan et al., 2008; Phillips & Seidman, 2008; Visser et al., 2020) as well as all included reports was reviewed. This strategy yielded 1,415 reports.

Fourth, to improve the likelihood of gathering relevant but unpublished studies that qualify for the meta-analysis, individual emails were sent to 17 researchers who authored at least two qualified reports and/or major reviews in this field from 2008 to 2018. This direct-contact strategy yielded two additional reports.

Across these four search strategies, 10,364 reports were collected, of which 6,157 remained after removing duplicates (see Figure 1, for a complete flowchart of the selection process).

Study Selection

All 6,157 reports were evaluated by the first author according to the inclusion and exclusion criteria outlined above in two steps. First, an initial screening of titles and abstracts was performed using a broadened version of the criteria. Specifically, a report was retained if it met the following four criteria: (a) was written in or could be translated into English (using Google Translate), (b) appeared to contain empirical findings, (c) examined human participants that were not exclusively limited to neurological and/or medical conditions (e.g., ketamine-induced psychosis), and (d) mentioned the comparison of at least one HR group of any kind to a control group. Affective experience was not set as an initial screening criterion because it was frequently not a key study objective and subsequently not mentioned in the title and abstract. The initial title/abstract screening step was carried out in Abstracker, an online software that ordered reports based on machine learning prediction of relevance that was updated daily (Wallace et al., 2012). Based on these criteria, 1,932 reports were retained and sought for full-text retrieval for the second step of screening. After extensive use of internet searches and interlibrary loans as well as contacting the corresponding author when necessary, 1,916 full-text reports were retrieved, and 16 were not retrievable. For these full-text reports, the Method and Results sections were read in their entirety and evaluated according to the full inclusion/exclusion criteria. In all, 197 reports qualified for inclusion in the meta-analysis with reasons for exclusion shown in Figure 1. Studies that met the inclusion criteria but were excluded due to insufficient information to calculate an effect size are listed in the Supplemental Materials.

From the 197 qualified reports, we identified 181 independent studies contributing 995 relevant effect sizes. Studies based on overlapping samples, such as when they drew from the same larger scale project or when multiple HR groups were compared to the same control group, were considered as one study for the purpose of its inclusion in the meta-analysis. Unless otherwise specified, all information was coded/constructed at the effect-size level.

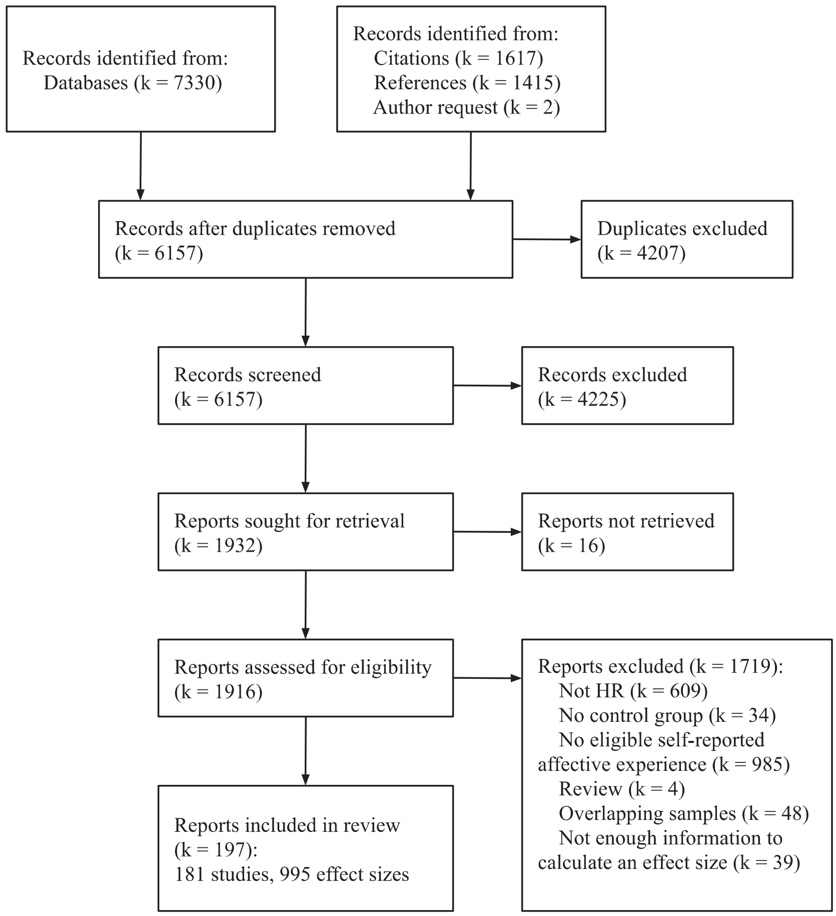
Coding Procedure

The coding protocol included five primary sections: article characteristics, setting characteristics, sample characteristics, information regarding the affective experience variable, and effect sizes. Each study was independently coded by the first author and either the third author or a trained research assistant. Both double coders underwent rigorous training sessions, practiced independent coding on at least six studies (or until above 90% agreement was achieved), and participated in weekly check-in meetings with the first author. After superficial discrepancies were resolved (e.g., typo), the interrater agreement across all codes was high ($M = 95.97\%$, $SD = 3.07$, range = 84.52–100). Discrepancies were resolved through extensive discussion between coders.

Primary Outcome Variables: Affective Experience Categories

Affective experiences were categorized by whether the measures assessed (a) trait or state affect; (b) at baseline or after affect induction (i.e., neutral, pleasant, or unpleasant); and (c) using unipolar PA, unipolar NA, or bipolar scale. In total, there were 14 categories. That is, trait PA, trait NA, and state experience (unipolar PA, unipolar NA, and bipolar) were measured at baseline as well as in response to neutral, pleasant, and unpleasant stimuli. These affective experience categories were treated as separate outcomes due to their conceptual distinctions (Cohen & Minor, 2010; Horan et al., 2008).

Figure 1
Flow of Study Reports Into the Research Synthesis



Note. HR = high-risk.

Trait Affective Experience Types

We coded author provided label and scale used for each affective experience variable. The labels and scales were then used to derive several trait affective experience types following the categorization of previous narrative reviews on this topic (Horan et al., 2008; Phillips & Seidman, 2008), theoretical distinctions (e.g., social vs. physical pleasure), and availability in the literature. For trait PA, we constructed the following types: (a) hedonia, including anticipatory physical pleasure, consummatory physical pleasure, social pleasure, and trait positive mood; (b) anhedonia, including physical anhedonia and social anhedonia; and (c) personality, including extraversion, novelty seeking, and reward dependence. For trait NA, we constructed the following types: (a) trait negative mood, including anxiety-related and others; and (b) personality, including neuroticism, harm avoidance, and other temperament.

State Affective Experience Procedures

For baseline state experiences, we coded whether they were based on daily life experience sampling methods. For induced state experiences, we coded the type of induction stimulus following commonly used categorizations (Quigley et al., 2014). Induction stimulus types included video clips, images (e.g., pictures and faces), behavioral tasks (e.g., motivated performance tasks and social interactions), imagery and recall, sounds and voices (e.g., sound clips and vocal stimuli), and other sensory stimuli (olfactory, gustatory, and somatosensory). We also coded whether participants were asked to rate in reference to their own experience or the stimulus itself.

Sample Characteristics

Sample characteristics included sample type (e.g., college students), HR approach (FHR, psychometric HR positive, psychometric HR negative, psychometric HR disorganized, psychometric HR total, Cluster A PD, vs. CHR), presence of clinical diagnosis (e.g., depressive disorders), percentage of males, mean age, percentages of White and non-White participants, and whether HR and control groups were matched on demographic characteristics (i.e., sex, age, race/ethnicity, and education).

Quality Bias Indices

We coded the following information to assess the risk of bias arising from the quality of method and reporting: whether the affective experience measure was validated, whether reliability was reported for the affective experience measure, whether the induction stimulus was validated (for induced states only), and whether effect size was reported for the outcome. A measure or stimulus was considered validated if the authors explicitly stated using a measure/stimulus validated by previous research without adaptation and provided a citation.

Study Characteristics

Study-level information included publication status, year of appearance (i.e., publication or work completion), and country of origin (e.g., United States). A country was categorized as Western if it is strongly shaped by Western cultural practices and has gross domestic product per capita higher than $10,000 USD, following the classification used by the International Epidemiological Association (Seniori Costantini et al., 2015). In this meta-analysis, Western countries included Western European and Balkan countries, United States, Canada, and Australia. All other countries were categorized as non-Western, including those in Eastern Europe, South America, and Asia.

Effect Size Calculation

Hedges' g was selected as the effect size estimate to quantify the standardized difference between HR and control groups in self-reported affective experience. Given that the relation of interest represents group differences on a continuous variable that is commonly measured using different scales, the standardized mean difference (i.e., Cohen's d and Hedges' g) is most appropriate to capture this relation while also being comparable across studies (Borenstein et al., 2009). Hedges' g, rather than Cohen's d, was chosen because Cohen's d has a slight overestimation bias for studies with a small sample size (Borenstein et al., 2009). To calculate Hedges' g, we first calculated Cohen's d from the descriptive statistics whenever possible (i.e., mean, standard deviation, and sample size). Inferential statistics were used if descriptive statistics were not available. Effect size estimates were reverse coded when necessary, so that greater unipolar scores reflect higher PA or NA, whereas greater bipolar scores reflect higher PA. A correction factor was then applied to convert Cohen's d to the unbiased Hedges' g (Hedges, 1981).

When information was unclear or insufficient to calculate an effect size from the report, we contacted the corresponding author for further details. In particular, we thoroughly checked the calculated effect size against other information in the report and reached out for clarification if any inconsistency was identified (e.g., the authors reported a nonsignificant result, but the calculated effect size was extremely large).

Missing Data

Some demographic information was not explicitly reported, and we handled such missing data using the "infer, initiate, impute" method suggested by Pigott and Polanin (2020). We first used other information to derive a well-reasoned estimate whenever possible. For example, we coded the demographic information from other related reports if the samples were drawn from the same larger scale project. If the authors stated that the sample consisted of college freshman, we coded the average age as 18.5 years old (Polanin et al., 2021). If there was not enough information for the inference stage, we then contacted the corresponding author directly for the missing demographic information. As the last step, we sought to multiply impute missing data. Only four variables had missingness: percentage of males (0.30%), mean age (0.40%), percentage of White participants (43.52%), and whether HR and control groups were matched on demographic characteristics (1.21%). The percentage of White participants was excluded from analysis due to the large proportion of missing data. Because of the multilevel nature of our data set (i.e., effect sizes nested within studies), we conducted multilevel multiple imputations using the *mice* package from R (van Buuren & Groothuis-Oudshoorn, 2011). The imputation model included all variables with missingness along with 16 additional variables, including HR approach, affective experience category, and effect size (see Supplemental Materials, for the full list of variables). Twenty-five complete data sets were estimated, each with 30 maximum iterations, and were then pooled to estimate the final complete data set.

Statistical Analysis

Analyses were conducted using random-effects models, as they assume that differences across observed effect sizes result from both sampling error and true variation among effect sizes (Borenstein et al., 2009). There is a consensus that schizophrenia is the result of polygenic risk, which contributes to highly heterogeneous profiles in terms of severity and symptom presentation (Giegling et al., 2017; Henriksen et al., 2017). As a result, there are likely genuine differences in affective experience across different populations of HR individuals, which is conceptually aligned with the theoretical assumption underlying the random-effects model.

Many studies provided multiple assessments of affective experience based on the same sample, creating dependency among effect sizes from the same study. To account for this dependency, a three-level multivariate model with robust variance estimation (Assink & Wibbelink, 2016; Hedges et al., 2010; Van den Noortgate et al., 2013), sometimes called a correlated and hierarchical effects model (Harrer et al., 2021; Pustejovsky & Tipton, 2022), was conducted to estimate the inverse-variance weighted effect size for each affective experience category separately, which we refer to as the overall effect sizes. The average correlation among dependent effect sizes was assumed to be .5. Sensitivity analyses with an average correlation of .8 yielded the same pattern of results.

To evaluate the potential impact of outliers, we conducted sensitivity analyses using the leave-one-out method in which the overall effect sizes were re-estimated with one study excluded each time (Harrer et al., 2021). To evaluate the possibility of publication bias, we visually inspected funnel plots displaying the relation between effect size magnitude and sample size. If there is no publication bias, we would expect to see effect sizes scattered symmetrically around the overall effect size estimate in the shape of a funnel (i.e., larger variability in the effect size magnitude for effect sizes with smaller sample sizes). Further, publication bias was tested by examining whether sample size and publication status were significantly associated with overall effect sizes.

We next examined whether bias, sample, and study characteristics should be included as covariates in the final, full models described below. Following the approach by Polanin et al. (2022), the association between these characteristics and effect sizes was tested in three multivariate metaregression models with robust variance estimation based on (a) bias indicators, (b) sample characteristics, or (c) study characteristics for each affective experience category. Any statistically significant variable was retained and entered in a combined meta-regression model. Variables that remained statistically significant in this combined model were included as covariates in the full models that included all a priori moderators. To evaluate the potential impact of our missing data technique, we conducted sensitivity analyses by comparing results of covariate analyses using listwise deletion against that of the complete data set with imputed data.

We then examined the association of a priori moderators (i.e., elicitation/assessment methods and HR approaches) with effect sizes using multivariate metaregression with robust variance estimation. Specifically, these models combine all a priori moderators regardless of their statistical significance with exploratory covariates that were statistically significant based on the above process, producing separate full models for each affective experience category. Although multivariate models can accommodate collapsing across broad categories of outcomes with different patterns of moderators—arguably a preferable approach to doing so—we modeled affective experience categories separately for consistency with prior research and theory (Cohen & Minor, 2010; Horan et al., 2008). For categorical moderators with more than two categories, a statistically significant omnibus test was followed by pairwise comparisons with a false discovery rate adjustment (Benjamini & Hochberg, 1995).

We used t statistics to test the statistical significance of individual model coefficients along with their corresponding confidence intervals and F statistics for the omnibus tests. The statistical significance threshold was set at $p < .05$. We conducted an a priori power analysis based on the median sample size (26 HR and 32 controls) and assumed a random-effects model with moderate heterogeneity (Harrer et al., 2021). Results indicated that four studies were needed to achieve 80% power to detect a standardized mean difference of 0.50. Thus, any overall effect size analysis or moderator categories involving fewer than four studies should be interpreted with some caution. All analyses were run in *R* (R Core Team, 2022) using the *metafor* package, Version 3.0-2 (Viechtbauer, 2010) and *clubSandwich* package, Version 0.5.5 (Pustejovsky, 2022).

Heterogeneity Analysis

We evaluated heterogeneity both visually and statistically. Visually, forest plots display effect sizes and their confidence intervals (Harrer et al., 2021) while also visualizing the variation among effect sizes and differences in them when multiple meta-analyses have been conducted, as in our case. Statistically, heterogeneity was examined via the Q statistic for its statistical significance, I^2 and τ (tau) statistics separately at the effect size and study levels, and 95% prediction intervals (PIs) around overall effect size estimates. For overall effect sizes, I^2 reflects the proportion of total variance due to true heterogeneity rather than sampling error but is not an absolute index of heterogeneity (Harrer et al., 2021; Higgins et al., 2003). Following conventions, an I^2 of 25%, 50%, and 75% represents small, moderate, and substantial heterogeneity, respectively (Higgins et al., 2003). The τ statistic, on the other hand, was estimated as the standard deviation of the true heterogeneity in effect sizes or studies, expressed on the same scale as the overall effect size estimates (Harrer et al., 2021). We also report PIs for the overall effect sizes that estimate where true effect sizes may appear in future studies (IntHout et al., 2016). For moderator results, we report τ along with the reduction in, and statistical significance of, residual (unexplained) heterogeneity. Taken together, these ways of evaluating observed variation among effect sizes can offer both descriptive and predictive information about effect size estimates in a meta-analysis (Harrer et al., 2021; Melsen et al., 2014).

Transparency and Openness

To facilitate transparency and reproducibility of our results, we followed Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) reporting guidelines (Page et al., 2021). The PRISMA checklist can be found in Supplemental Tables S1 and S2. Coding manual, data set, and reproducible R code are available online at the Open Science Framework (https://doi.org/10.17605/OSF.IO/BVRXS). This meta-analysis was not preregistered.

Results

Descriptive Characteristics

Overall, 181 independent studies from 1970 to 2020 contributed 995 effect sizes. The average study sample size was 53.44 HR (SD = 63.58, range = 3–489) and 85.00 control participants (SD = 175.39, range = 10–1724), resulting in a total of 9,672 HR and 15,386 controls. Of the 181 studies, 47 studies included FHR, 52 included psychometric HR positive, 49 included psychometric HR negative, 2 included psychometric HR disorganized, 27 included psychometric HR total, 11 included Cluster A PD, and 23 included CHR; some studies used multiple HR approaches. Most studies were written in English (99.45%), published (89.50%), conducted in a Western country (78.45%), and did not report a clinical diagnosis for HR participants (81.77%). For studies that did report a clinical diagnosis, the majority noted the presence of depressive and other mood disorders (75.76%). About half of the studies came from the United States (45.30%) and used college samples (48.62%). The study samples were 46.12% male (SD = 20.27, range = 0–100), with an average age of 26.25 (SD = 10.20, range = 15.72–61.72). Additional descriptive information is reported separately for each affective experience category (see Supplemental Tables S3 and S4). Individual study characteristics can be found in the Supplemental Materials.

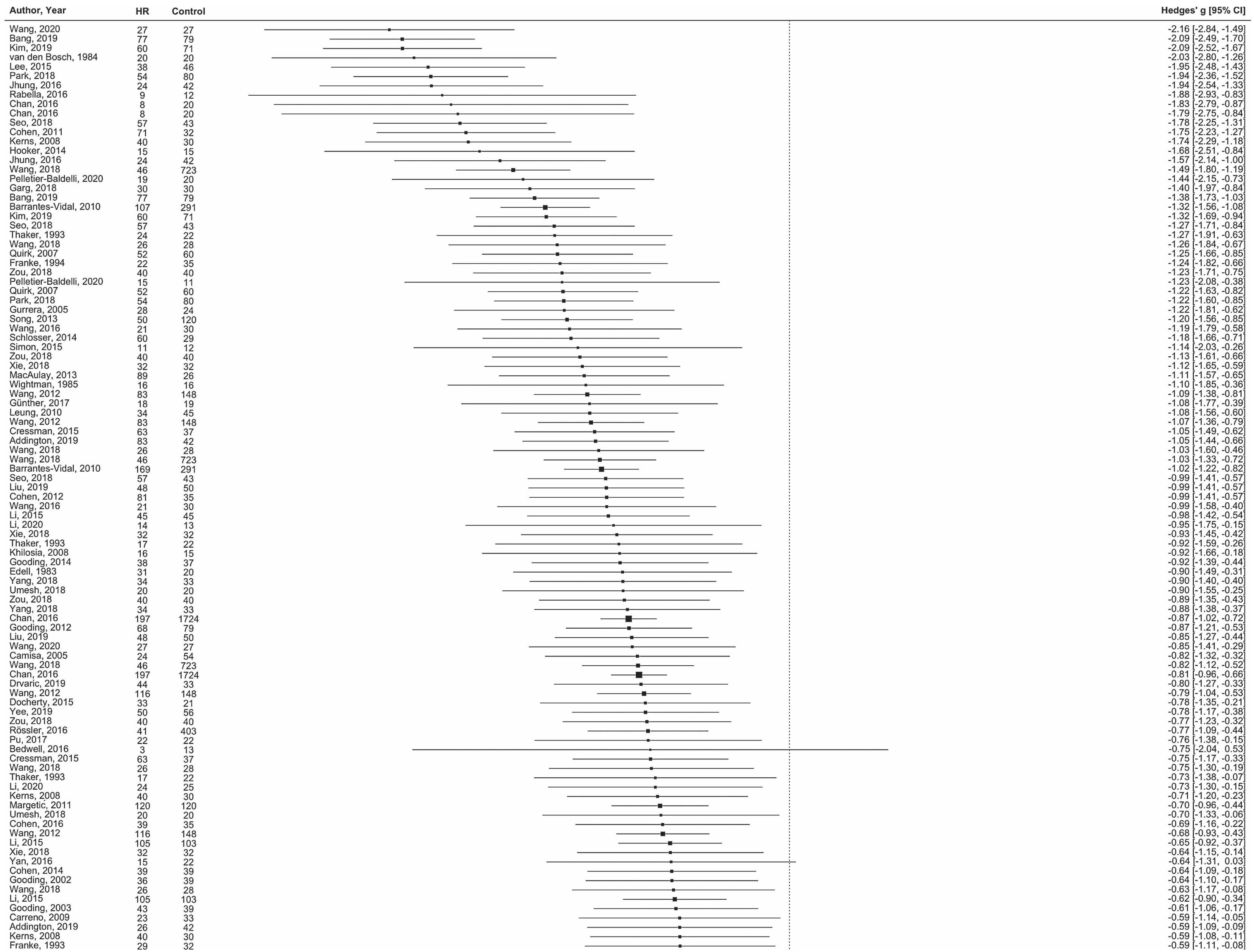
Heterogeneity Results

Heterogeneity was evaluated both visually and statistically. Visually, forest plots (see Figures 2 and 3, for trait PA and trait NA; see Supplemental Materials, for all other affective experience categories) illustrate the large amount of variation among effect sizes and degree to which it differs across affective experience categories. The substantial heterogeneity is perhaps most obvious in Figure 3, the forest plot for trait NA. Statistically, trait NA also serves as a prime example of the heterogeneity among effect sizes found in our meta-analyses. As reported below, although the estimated overall effect size is large and statistically significant (g = 0.74, 95% CI [0.60, 0.87]), the associated τ statistics are large ($\tau_{\text{effect-size}} = 0.34$, 95% CI [0.25, 0.46]; $\tau_{\text{study}} = 0.47$, 95% CI [0.32, 0.62]), resulting in a wide 95% PI [−0.40, 1.88]. That is, it would be reasonable to expect true effect sizes to be between −0.40 and 1.88 for future studies on trait NA differences between HR and control groups.[2] Given this

[2] We thank one of the reviewers for providing this example and highlighting its implications.

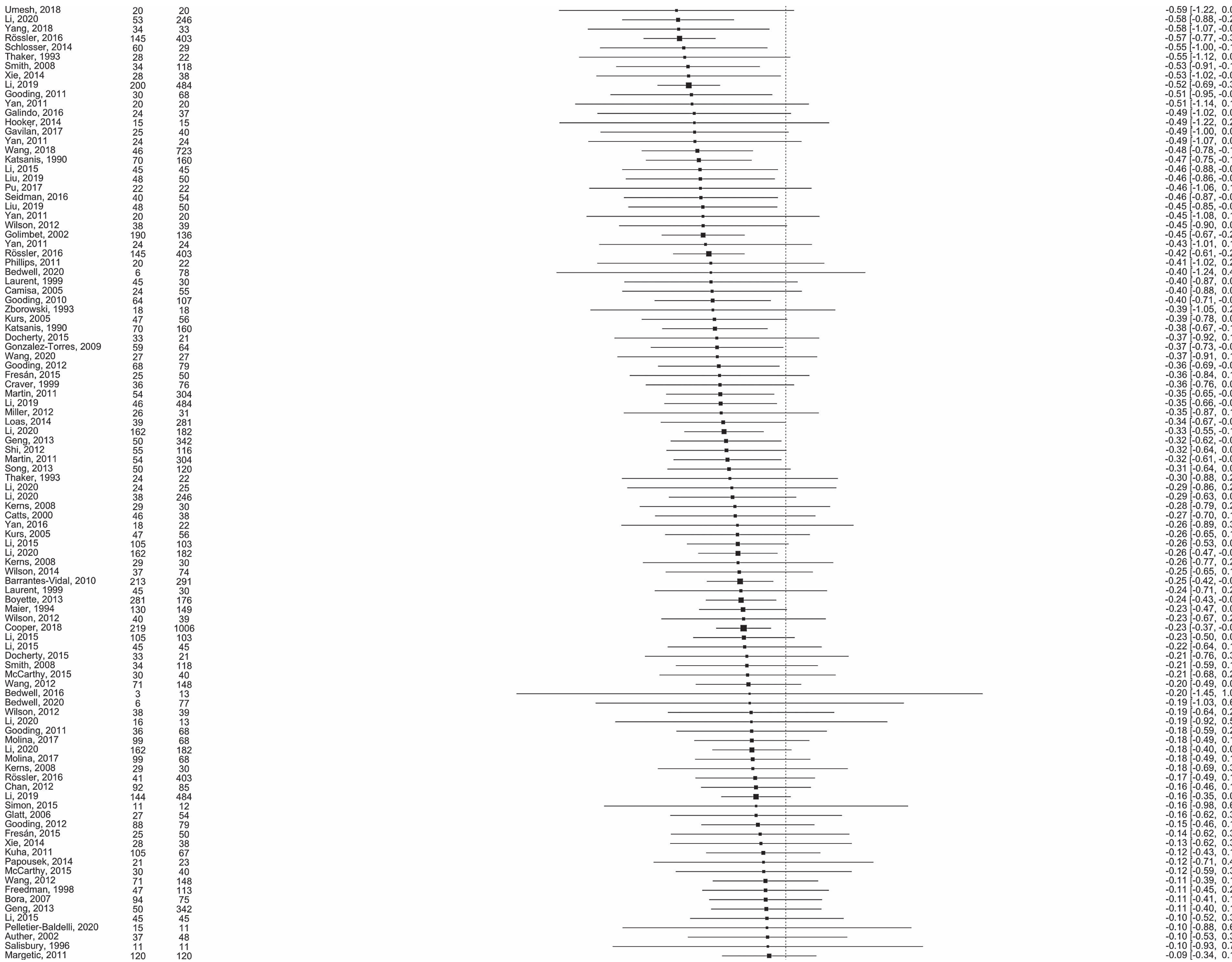
Figure 2

Forest Plot of Effect Sizes Included in the Meta-Analysis for Trait Positive Affect



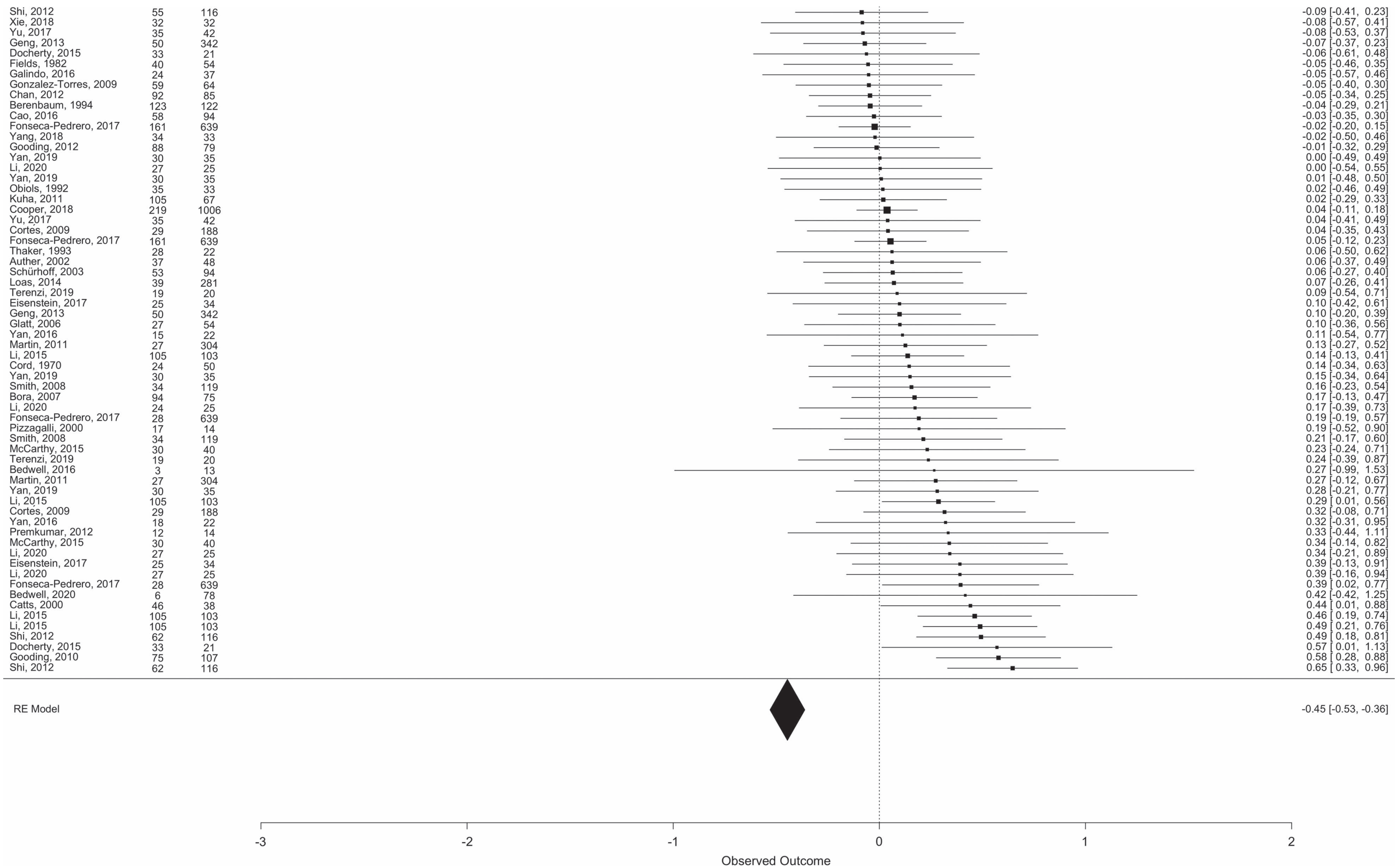
(figure continues)

Figure 2 (*continued*)



(*figure continues*)

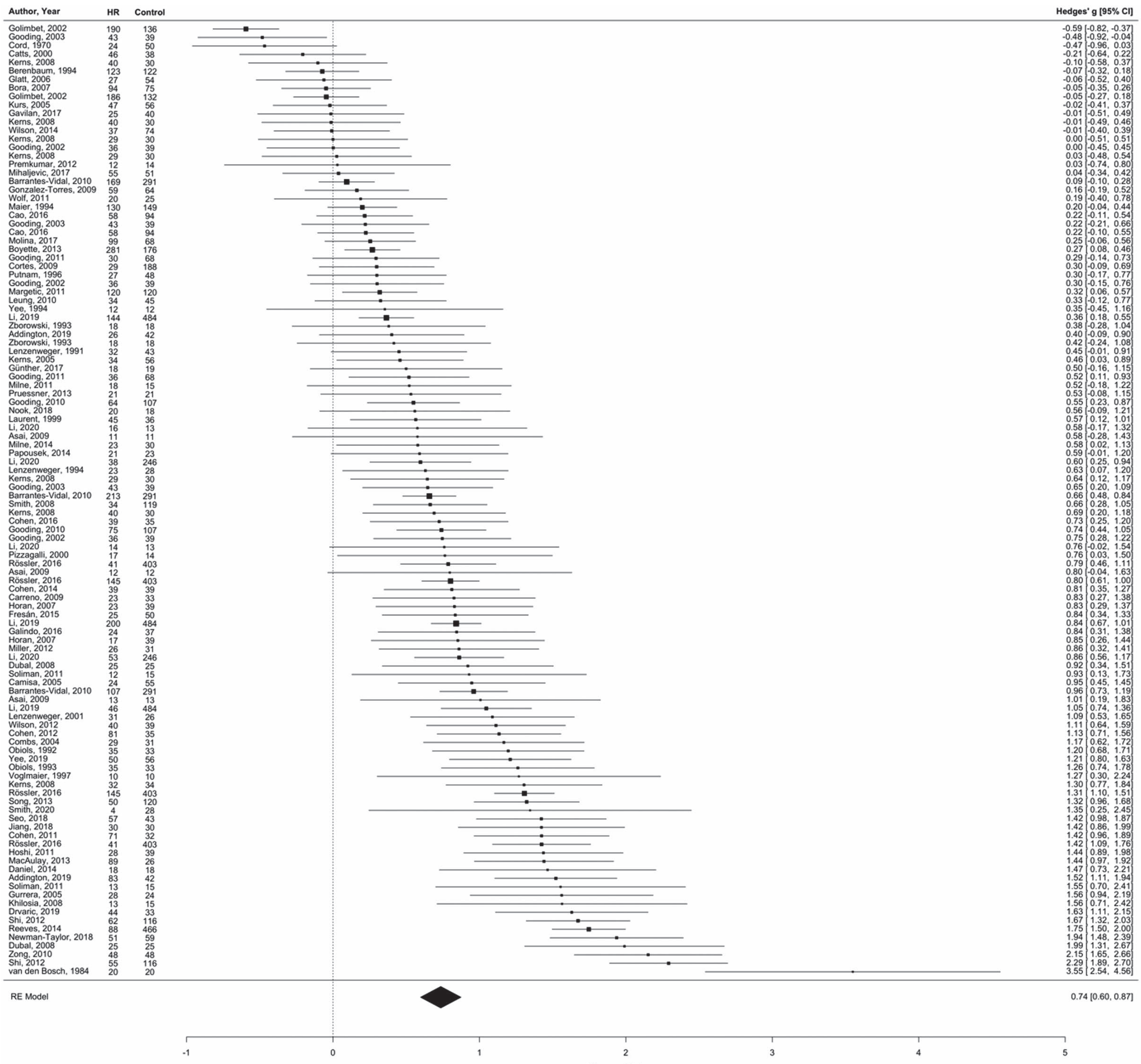
Figure 2 (*continued*)



Note. Positive and negative effect sizes represent HR reporting higher and lower positive affect than controls, respectively. HR = high-risk; CI = confidence interval.

Figure 3

Forest Plot of Effect Sizes Included in the Meta-Analysis for Trait Negative Affect



Note. Positive and negative effect sizes represent HR reporting higher and lower negative affect than controls, respectively. HR = high-risk; CI = confidence interval.

presence of substantial heterogeneity, average effect sizes, which are reported next, should be interpreted with caution (Greenland & O'Rourke, 2008). Alongside the results from overall and moderator analyses, we also report heterogeneity statistics specific to them.

Overall Effect Sizes

The weighted average effect size estimate for each affective experience category is shown in Table 1. Relative to controls, HR participants reported a statistically significant reduction in trait PA ($g = -0.45$, 95% CI [−0.53, −0.36], 95% PI [−1.34, 0.45], leave-one-out range = −0.45 to −0.43) and elevation in trait NA ($g = 0.74$, 95% CI [0.60, 0.87], 95% PI [−0.40, 1.88], leave-one-out range = 0.71–0.75). Mirroring the results for trait affect, state baseline experiences for HR (vs. controls) showed a statistically significant reduction in PA ($g = -0.24$, 95% CI [−0.36, −0.11], 95% PI [−0.70, 0.23], leave-one-out range = −0.26 to −0.21) and elevation in NA ($g = 0.62$, 95% CI [0.50, 0.74], 95% PI [−0.042, 1.28], leave-one-out range = 0.60–0.63). On the other hand, state baseline experiences measured using bipolar scales, for which only

Table 1
Overall Effect Sizes

Affective experience	$N_{studies}$	$N_{effects}$	N_{HR}	$N_{Control}$	Hedges' *g* (*SE*)	95% CI	*Q* (*df*)	*p*	L2: τ, I^2	L3: τ, I^2	95% PI
Trait affect											
PA	108	265	7,207	11,633	−0.45 (0.043)***	−0.53, −0.36	1693.10 (264)	<.001	0.34, 47.76	0.30, 38.00	−1.34, 0.45
NA	79	112	4,740	5,528	0.74 (0.070)***	0.60, 0.87	982.10 (111)	<.001	0.34, 30.02	0.47, 59.81	−0.40, 1.88
State baseline											
PA	27	46	1,250	1964	−0.24 (0.058)***	−0.36, −0.11	116.51 (45)	<.001	0.23, 50.55	0.048, 2.12	−0.70, 0.23
NA	51	87	1939	2,910	0.62 (0.058)***	0.50, 0.74	218.32 (86)	<.001	0.20, 21.95	0.27, 42.78	−0.042, 1.28
Bipolar	3	9	120	105	−0.72 (0.24)	−1.80, 0.36	11.15 (8)	.19	0.012, 0.077	0.32, 52.95	−1.35, −0.092
State induction											
Neutral stimuli											
PA	23	29	782	870	−0.22 (0.069)**	−0.36, −0.070	83.97 (28)	<.001	0.27, 51.86	<0.001, <0.001	−0.74, 0.31
NA	24	39	774	923	0.25 (0.066)**	0.11, 0.39	60.95 (38)	.010	0.17, 24.92	0.10, 8.49	−0.14, 0.64
Bipolar	26	56	684	812	−0.23 (0.055)***	−0.34, −0.11	69.86 (55)	.086	0.16, 21.97	<0.001, <0.001	−0.54, 0.092
Pleasant stimuli											
PA	29	46	970	982	−0.28 (0.063)***	−0.41, −0.15	69.37 (45)	.011	0.045, 1.66	0.22, 40.92	−0.72, 0.16
NA	17	33	497	605	0.38 (0.090)***	0.19, 0.57	47.90 (32)	.035	<0.001, <0.001	0.27, 47.24	−0.15, 0.91
Bipolar	27	59	733	791	−0.20 (0.085)*	−0.38, −0.030	143.06 (58)	<.001	0.26, 29.25	0.27, 31.20	−0.93, 0.52
Unpleasant stimuli											
PA	21	48	553	665	−0.009 (0.065)	−0.15, 0.13	85.04 (47)	<.001	0.23, 36.48	<0.001, <0.001	−0.45, 0.44
NA	31	104	940	994	0.32 (0.092)**	0.13, 0.50	239.66 (103)	<.001	0.17, 10.15	0.41, 57.79	−0.55, 1.19
Bipolar	28	62	751	881	0.010 (0.062)	−0.12, 0.14	104.23 (61)	<.001	0.21, 30.82	0.082, 4.93	−0.42, 0.44

Note. The sample size for high-risk (HR) and control groups was calculated at the study level (sum of averaged effect-size level sample size). *p* = statistical significance for the *Q* statistic; L2 = Level 2 (effect-size level); L3 = Level 3 (study level); PI = prediction interval; PA = positive affect; NA = negative affect; CI = confidence interval; *SE* = standard error.
* $p < .05$. ** $p < .01$. *** $p < .001$.

three studies were available, showed a statistically nonsignificant PA reduction/NA elevation for HR (vs. controls; $g = -0.72$, 95% CI [−1.80, 0.36], 95% PI [−1.35, −0.092], leave-one-out range = −0.97 to −0.48). A similar pattern was also observed for state experiences in response to induction stimuli. Participants who are at HR (vs. controls) reported a statistically significant reduction in state PA in response to both neutral ($g = -0.22$, 95% CI [−0.36, −0.070], 95% PI [−0.74, 0.31], leave-one-out range = −0.24 to −0.19) and pleasant stimuli ($g = -0.28$, 95% CI [−0.41, −0.15], 95% PI [−0.72, 0.16], leave-one-out range = −0.30 to −0.26), but not in response to unpleasant stimuli ($g = -0.009$, 95% CI [−0.15, 0.13], 95% PI [−0.45, 0.44], leave-one-out range = −0.035–0.022). On the other hand, participants who are at HR (vs. controls) reported a statistically significant elevation in state NA in response to neutral ($g = 0.25$, 95% CI [0.11, 0.39], 95% PI [−0.14, 0.64], leave-one-out range = 0.20–0.28), pleasant ($g = 0.38$, 95% CI [0.19, 0.57], 95% PI [−0.15, 0.91], leave-one-out range = 0.33–0.40), and unpleasant stimuli ($g = 0.32$, 95% CI [0.13, 0.50], 95% PI [−0.55, 1.19], leave-one-out range = 0.28–0.35). Similarly, when induced state experiences were measured using bipolar scales, HR (vs. controls) reported a statistically significant PA reduction/NA elevation in response to neutral ($g = -0.23$, 95% CI [−0.34, −0.11], 95% PI [−0.54, 0.092], leave-one-out range = −0.25 to −0.20), pleasant ($g = -0.20$, 95% CI [−0.38, −0.030], 95% PI [−0.93, 0.52], leave-one-out range = −0.25 to −0.18), but not unpleasant stimuli ($g = 0.010$, 95% CI [−0.12, 0.14], 95% PI [−0.42, 0.44], leave-one-out range = −0.008–0.053). The robustness of these findings is supported by the results of leave-one-out sensitivity analyses. Thus, HR individuals displayed deficient PA (except when reacting to unpleasant stimuli) and heightened NA across trait and state.

Heterogeneity analyses indicated substantial variation for trait affective experiences (total I^2 of 85.76 for PA and 89.83 for NA), moderate-to-high variation for baseline state experiences (total I^2 of 52.67 for PA, 64.72 for NA, and 53.03 for bipolar experiences), and low-to-moderate variation for induced state experiences (total I^2 ranged from 21.97 to 67.94). A similar pattern was also observed for τ, with the amount of heterogeneity being the largest for trait effect sizes, followed by effect sizes for baseline and induced states. Last, 95% PIs were relatively wide for all affective experience categories. Together, these statistics provide an empirical rationale for conducting moderator analyses along with reason for caution when interpreting average effect sizes (Greenland & O'Rourke, 2008). Before examining potential moderators within these affective experience categories, three patterns of the overall effect sizes are notable.

First, as hypothesized, it appears that the overall effect sizes decreased in magnitude from trait to state. To formally test these differences, we conducted a moderator analysis examining the relation between broad affective experience categories (i.e., trait vs. state baseline vs. state induction) and effect sizes. Effect sizes for unipolar NA were first reverse coded so that a positive effect size represents HR reporting higher PA/lower NA than controls (i.e., less disturbance) and a negative effect size represents HR reporting lower PA/higher NA than controls (i.e., more disturbance). Results partially supported our hypothesis: induced state disturbances ($g = -0.22$, $SE = 0.042$, 95% CI [−0.30, −0.13]) were statistically significantly weaker than that of trait ($g = -0.54$, $SE =$ 0.043, 95% CI [−0.62, −0.45]), $t(46.87) = 5.23$, $p < .001$, and baseline state ($g = -0.46$, $SE = 0.053$, 95% CI [−0.56, −0.35]), $t(18.05) = 3.88$, $p = .002$. Trait disturbances did not statistically significantly differ from baseline state disturbances, $t(45.08) =$ -1.22, $p = .23$.

Second, as hypothesized, it appears that the overall effect size magnitude was greater for NA than PA. To formally test this difference, we conducted a moderator analysis examining the relation between valence (i.e., PA vs. NA) and effect sizes. Again, effect sizes for unipolar NA were first reverse coded. Results supported our hypothesis: NA disturbances ($g = -0.63$, $SE = 0.058$, 95% CI [−0.74, −0.51]) were statistically significantly stronger than PA disturbances ($g = -0.36$, $SE = 0.046$, 95% CI [−0.45, −0.26]), $t(42.10) = -3.34$, $p = .002$.

Third, as hypothesized, it appears that the use of bipolar (vs. unipolar) scales resulted in weaker state disturbances. To formally test this difference, we conducted a moderator analysis examining the relation between scale types (i.e., unipolar vs. bipolar) and effect sizes. Again, effect sizes for unipolar NA were first reverse coded. Results supported our hypothesis: state disturbances measured using bipolar scales ($g = -0.18$, $SE = 0.042$, 95% CI [−0.26, −0.090]) were statistically significantly weaker than those measured using unipolar scales ($g = -0.37$, $SE = 0.036$, 95% CI [−0.44, −0.30]), $t(20.78) = 4.25$, $p < .001$.

Bias, Sample, and Study Characteristics

We investigated whether bias, sample, and study characteristics were associated with effect sizes for their potential inclusion as covariates.[3] Results for variables that showed a unique association with effect sizes, and thus included as covariates in the full models are described below. Full results are reported in Supplemental Tables S5–S17. Notably, sensitivity analyses indicated highly similar results between data sets with imputed data and those using listwise deletion (Supplemental Table S18), supporting the robustness of findings to our missing data technique.

Bias Indicators

With respect to publication bias, a funnel shape can be detected for all categories (see Supplemental Materials). Funnel plot asymmetry, as indicated by a statistically significant, negative association between sample size and effect size, was found for state PA in response to pleasant stimuli, $B = -0.005$, $SE = 0.001$, 95% CI [−0.008, −0.001], $t(3.52) = -4.03$, $p = .020$. That is, effect sizes showed stronger PA reduction with increasing sample size, suggesting that effect sizes are missing to the right of the mean. Additionally, publication status was a statistically significant predictor for state PA in response to pleasant stimuli, such that published studies reported a stronger PA reduction compared to unpublished ones, $B = -0.42$, $SE = 0.11$, 95% CI [−0.73, −0.10], $t(3.51) = -3.90$, $p = .022$. Thus, there appears to be an underreporting of HR showing higher PA than controls in response to pleasant stimuli in the published literature.

With respect to quality bias, only whether reliability was reported showed a statistically significant association with state bipolar experience in response to neutral stimuli. Specifically, the only effect size for which reliability was reported had a stronger PA reduction/NA elevation than those without reliability reported,

[3] Covariate and moderator analyses were not conducted for state baseline experiences measured using bipolar scales due to the low number of studies.

$B = -0.39$, $SE = 0.055$, 95% CI [−0.51, −0.28], $t(20.40) = -7.12$, $p < .001$.

Sample and Study Characteristics

In general, there were few sample and study characteristics that showed consistent relations across affective experience categories. The most common characteristic is mean age, trait PA: $B = 0.008$, $SE = 0.004$, 95% CI [0.001, 0.015], $t(28.54) = 2.23$, $p = .034$; trait NA: $B = -0.028$, $SE = 0.004$, 95% CI [−0.037, −0.018], $t(19.61) = -6.18$, $p < .001$; state NA measured at baseline: $B = -0.021$, $SE = 0.007$, 95% CI [−0.036, −0.006], $t(11.21) = -3.13$, $p = .009$; state NA in response to pleasant stimuli: $B = -0.041$, $SE = 0.009$, 95% CI [−0.078, −0.003], $t(2.15) = -4.37$, $p = .042$. That is, relations were weaker for increasing age. In addition, the percentage of males was a statistically significant predictor for state bipolar experience in response to unpleasant stimuli, $B = 0.006$, $SE = 0.002$, 95% CI [0.002, 0.011], $t(9.25) = 3.07$, $p = .013$, such that increasing percentages of males were associated with stronger PA elevations/NA reductions. Last, clinical diagnosis status was a statistically significant predictor for trait NA, with clinical samples having a stronger NA elevation than those without a diagnosis, $B = 0.56$, $SE = 0.21$, 95% CI [0.10, 1.02], $t(9.90) = 2.74$, $p = .021$.

Moderator Analyses

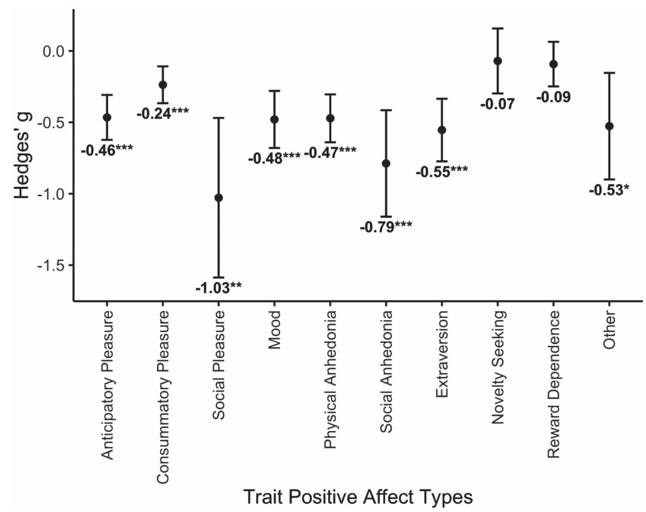
Trait Affective Experience Types

Trait PA. All trait PA types had a statistically significant PA reduction except reward dependence and novelty seeking (see Figure 4 and Supplemental Table S19). The full model for trait PA, which included trait PA type, HR approach, and the covariate of mean age, showed reduced heterogeneity at both effect-size and study levels ($\tau_{\text{effect-size}} = 0.22$, 95% CI [0.18, 0.26]; $\tau_{\text{study}} = 0.24$, 95% CI [0.18, 0.32]), with statistically significant residual heterogeneity, $Q(248) = 909.36$, $p < .001$. The omnibus test on the full model indicated that trait PA type statistically significantly moderated the effect size, $F(9, 22.86) = 5.73$, $p < .001$. Follow-up pairwise comparisons showed that measures assessing social pleasure, social anhedonia, and physical anhedonia had statistically significantly stronger PA reduction than measures assessing consummatory pleasure and reward dependence (all $p < .048$). In addition, measures assessing consummatory pleasure were statistically significantly weaker than those assessing mood, $B = 0.31$, $SE = 0.10$, 95% CI [0.099, 0.53], $t(25.56) = 3.00$, $p = .035$, and anticipatory pleasure, $B = 0.22$, $SE = 0.049$, 95% CI [0.12, 0.32], $t(23.63) = 4.42$, $p = .008$. Measures assessing reward dependence were also statistically significantly weaker than those assessing extraversion, $B = 0.35$, $SE = 0.10$, 95% CI [0.13, 0.56], $t(16.61) = 3.38$, $p = .032$. Thus, HR individuals had the greatest trait PA deficit within the social domain (i.e., social pleasure, social anhedonia, extraversion) and were comparable with controls in PA-related temperaments (i.e., reward dependence and novelty seeking).

Trait NA. All trait NA types had a statistically significant NA elevation, except other temperament (see Figure 5 and Supplemental Table S20). The full model for trait NA, which included trait NA type, HR approach, and the covariates of mean age and clinical diagnosis, showed reduced heterogeneity at both effect-size and study levels ($\tau_{\text{effect-size}} = 0.32$, 95% CI [0.24, 0.42]; $\tau_{\text{study}} = 0.24$, 95% CI [<0.001, 0.39]), with statistically significant residual heterogeneity, $Q(99) = 487.13$, $p < .001$. The omnibus test on the full model did not indicate a statistically significant moderation, $F(4, 18.52) = 0.84$, $p = .52$. Thus, HR individuals had heightened trait NA across domains, and this disturbance is relatively lower for NA-related temperaments.

Figure 4

Effect Size Estimates for Trait Positive Affect Types



* $p < .05$. ** $p < .01$. *** $p < .001$.

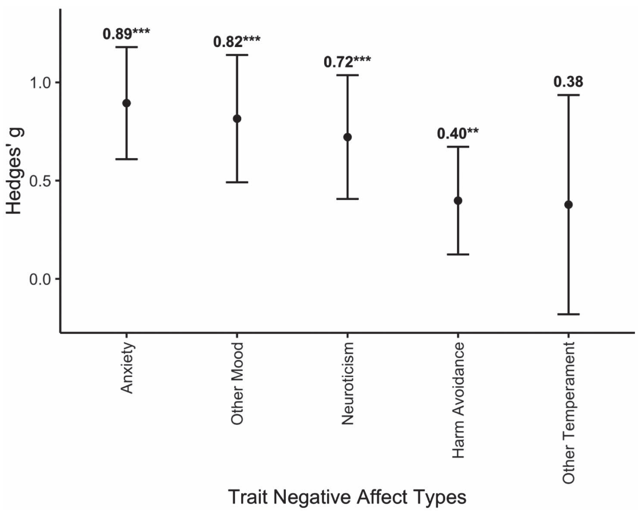
State Affective Experience Procedures

Experience sampling and stimulus types did not statistically significantly moderate any of the state experience effect sizes (see Supplemental Tables S21–S31). Rating reference was statistically significant for state PA in response to unpleasant stimuli, where the only effect size in reference to the stimulus had a stronger PA reduction than effect sizes in reference to participants' own experiences, $B = -0.64$, $SE = 0.13$, 95% CI [−1.10, −0.19], $t(2.49) = -5.07$, $p = .023$ (see Supplemental Table S29). It should be noted that results for rating reference were underpowered because participants were predominately asked to rate their own experiences. Thus, the use of different procedures to elicit and measure state affective experiences does not appear to produce robust differences, although more studies using stimulus-reference are needed before firm conclusions can be drawn.

HR Approaches

Average effect sizes for the relation between HR approach and affective experience category are graphically summarized in Figure 6 to aid in the interpretation. Apart from psychometric HR positive and negative, all other HR approaches contained fewer than four studies for at least one affective experience category. This is particularly true for psychometric HR disorganized, where it contained two effect sizes for trait PA, one effect size for trait NA, and no data for all other affective experience categories. Results are most complete for trait PA and trait NA.

Figure 5
Effect Size Estimates for Trait Negative Affect Types



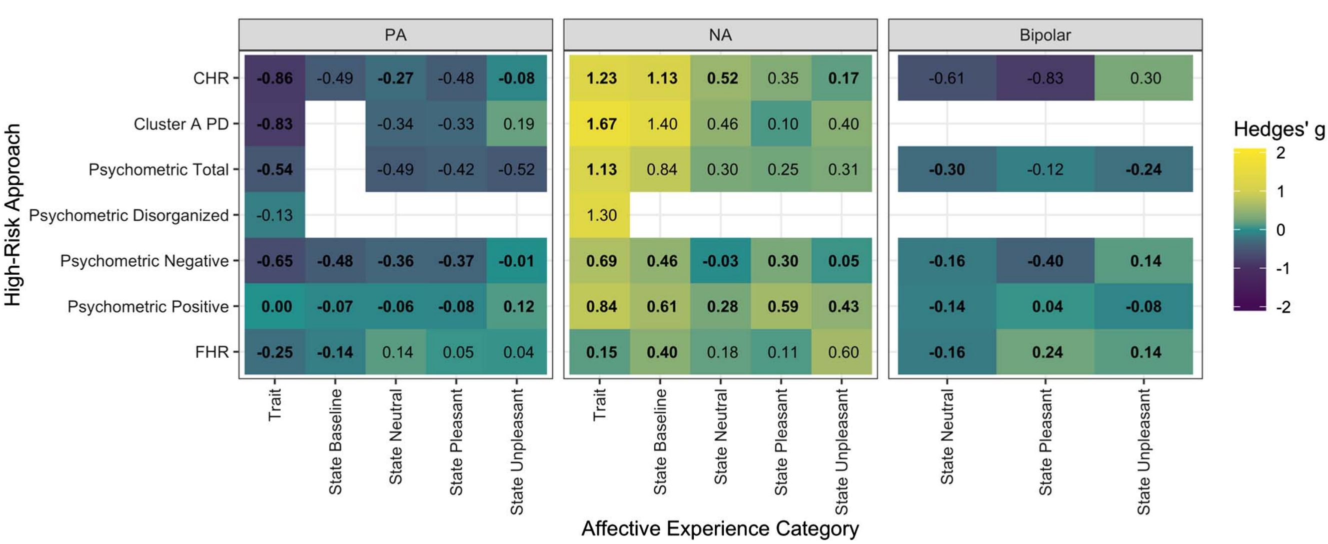
** $p < .01$. *** $p < .001$.

With respect to trait PA (Supplemental Table S19), all HR approaches showed a statistically significant PA reduction except psychometric HR positive. The omnibus test on the full model indicated that HR approach statistically significantly moderated trait PA effect size, $F(6, 27.43) = 35.90$, $p < .001$. Follow-up pairwise comparisons showed that psychometric HR positive had a statistically significantly weaker PA reduction than all other HR approaches (all $p < .013$), except when compared to FHR, $B = 0.19$, $SE = 0.16$, 95% CI [−0.15, 0.53], $t(32.46) = 1.15$, $p = .34$. FHR also had a statistically significantly weaker PA reduction than psychometric HR negative, $B = 0.46$, $SE = 0.16$, 95% CI [0.13, 0.79], $t(30.86) = 2.82$, $p = .019$, Cluster A PD, $B = 0.49$, $SE = 0.15$, 95% CI [0.13, 0.86], $t(6.74) = 3.23$, $p = .032$, and CHR, $B = 0.58$, $SE = 0.13$, 95% CI [0.30, 0.87], $t(14.78) = 4.36$, $p = .002$. In addition, psychometric HR disorganized had a statistically significantly weaker PA reduction than psychometric HR negative, $B = 0.41$, $SE = 0.063$, 95% CI [0.28, 0.54], $t(27.12) = 6.52$, $p < .001$, and CHR, $B = 0.54$, $SE = 0.11$, 95% CI [0.30, 0.77], $t(12.06) = 4.98$, $p = .002$. Thus, all HR approaches except psychometric HR positive showed trait PA deficits. The deficit was least severe for FHR and psychometric HR disorganized and most severe for psychometric HR negative, Cluster A PD, and CHR.

With respect to trait NA (Supplemental Table S20), all HR approaches showed a statistically significant NA elevation (statistical significance cannot be estimated for psychometric HR disorganized due to only one effect size). The omnibus test on the full model indicated that HR approach significantly moderated trait NA effect size, $F(6, 16.80) = 16.03$, $p < .001$. Follow-up pairwise comparisons showed that FHR, psychometric HR negative, and psychometric HR positive had a statistically significantly weaker NA elevation than psychometric HR disorganized, psychometric HR total, and CHR (all $p < .040$). FHR also had a statistically significantly weaker NA elevation than psychometric HR positive, $B = −0.48$, $SE = 0.15$, 95% CI [−0.79, −0.16], $t(14.44) = −3.24$, $p = .016$. Thus, all HR approaches showed heightened trait NA, with the disturbance being least pronounced for FHR, followed by psychometric HR negative and positive, and most pronounced for psychometric HR disorganized, psychometric HR total, and CHR.

Results for baseline and induced state affective experience categories were less complete but generally follow a similar pattern as trait PA and trait NA findings (see Supplemental Tables S21–S31). That is, for state PA, psychometric HR positive and FHR were not statistically significantly associated with any deficits and sometimes showed weakly elevated PA compared to controls. With the exception of state PA in response to unpleasant stimuli, where none of the HR approaches examined showed any statistically significant

Figure 6
Heatmap of Effect Sizes for the Relation Between High-Risk (HR) Approach and Affective Experience Category



Note. PA = positive affect; NA = negative affect; FHR = familial high risk; Cluster A PD = Cluster A personality disorder; CHR = clinical high risk. Empty cells represent relations for which no data were available. Effect size estimates with at least four studies are in bold. See the online article for the color version of this figure.

disturbances, state PA deficits were the strongest for psychometric HR negative and total. For state NA, FHR and psychometric HR negative had the weakest NA elevation, followed by psychometric HR positive; Cluster A PD and CHR had the strongest NA elevation. Due to the methodological confound associated with bipolar scales, state bipolar experiences only showed mostly nonsignificant and modest effect sizes for all HR approaches examined. The only statistically significant result was a PA reduction/NA elevation for psychometric HR negative in response to pleasant stimuli (g = −0.40, SE = 0.083, 95% CI [−0.58, −0.22]). The full model for state experiences generally showed reduced heterogeneity at both effect-size and study levels, and residual heterogeneity became statistically nonsignificant for state PA in response to pleasant stimuli, $Q(33) = 22.62$, $p = .91$, and state NA in response to pleasant stimuli, $Q(24) = 28.48$, $p = .24$.

Overall, in line with our hypotheses, FHR displayed the least affective disturbances, followed by psychometric HR, whereas Cluster A PD and CHR displayed the greatest disturbances. Also, mostly consistent with our hypotheses, heightened NA was found for all HR approaches, whereas PA deficits were more varied and did not characterize the psychometric HR-positive approach or when HR individuals were reacting to unpleasant stimuli.

Discussion

Disturbed affective experiences are a core and debilitating feature of the schizophrenia spectrum, but our understanding of the nature of these disturbances has remained elusive thus far. Delineating affective experience disturbances in HR individuals offers a valuable window into understanding the underlying affective vulnerability markers for schizophrenia that may inform the development of tailored prevention and treatment strategies. Consequently, the goal of the present meta-analysis was to estimate the overall magnitude of self-reported affective experience disturbances in HR individuals along the schizophrenia spectrum and identify moderators that may help parse the heterogeneity in extant studies. In the following sections, we start by summarizing the results for the heterogeneity analyses, overall analyses, and main moderators. These findings are then evaluated against several theoretical models proposed to explain affective experience disturbances in schizophrenia. We end by discussing limitations and outlining suggestions for future research.

Heterogeneity Results

Converging visual and statistical evidence points to a large amount of observed variation among effect sizes in our meta-analyses along with moderators that explain a modest proportion of it. The illustrative example of trait NA provided in the prior section shows the uncertainty of our average effect size estimates, which may be a rather crude starting point to predict results for future studies. How well a priori moderators explained this heterogeneity should also be questioned, in light of the small reduction in τ and statistically significant residual heterogeneity. This concern is not uncommon in modern meta-analyses, which often demonstrate considerable heterogeneity yet moderators that rarely explain it well, with emerging evidence of a correlation between the amount of heterogeneity and average effect sizes (IntHout et al., 2016; Linden & Hönekopp, 2021; Stanley et al., 2018). While this combination encourages caution when interpreting and translating the substantive findings discussed next, it also offers a valuable framing for future research as described later in this section.

Overall and Moderator Results

The meta-analytic findings reveal that HR individuals are characterized by profoundly heightened trait NA, with impairment becoming more modest, though still notable, from trait to state baseline, and then to state induction. Results for NA disturbances are robust, showed minimal bias, and generalized across trait experience types, state experience procedures, and HR approaches. It should be noted that NA disturbances, although observed for all HR approaches, typify individual approaches to varying degrees. As the degree of schizophrenia-spectrum risk increased from FHR to psychometric HR to Cluster A PD and CHR, the severity of NA disturbances increased accordingly. Therefore, consistent with previous narrative reviews on this topic (Horan et al., 2008; Phillips & Seidman, 2008), the meta-analytic evidence strongly indicates that heightened NA is characteristic of risk for schizophrenia.

To a lesser extent, HR individuals exhibited trait PA deficits with severity following the same decreasing pattern from trait to state. When reacting to unpleasant materials, HR individuals failed to show any clinically significant PA deficits. However, results for PA deficits in response to pleasant materials are less certain due to the presence of publication bias, where an underreporting of HR showing higher PA than controls was found. This publication bias is perhaps not surprising given that a heightened PA is inconsistent with the well-documented PA deficit at the trait level (e.g., anhedonia) as well as arguments of a “schizophrenia spectrum anhedonia paradox” that HR individuals, in contrast to individuals with schizophrenia, do show state anhedonia (Strauss & Cohen, 2018). Further, PA deficits are generalized across state experience procedures but are relatively more variable across trait experience types and HR approaches. HR individuals showed a severe trait PA deficit within the social domain, therefore substantiating previous theories of a social-specific hedonic dysfunction (Cohen et al., 2011; Meehl, 1962, 1990). With respect to HR approaches, PA deficits follow a severity gradient that corresponds well with the levels of schizophrenia-spectrum risk but showed differential relations with symptom dimensions. Only the negative, but not positive, dimension is characterized by PA deficits across trait and state. Therefore, evidence moderately indicates that select PA deficits (e.g., social) may play a role in the development of some aspects of schizophrenia (e.g., negative symptoms).

For state affective experiences based on bipolar scales, disturbances mirror that of unipolar scales but showed a general reduction in magnitude. A closer examination of effect sizes within each HR approach reveals that compared to unipolar effect sizes, bipolar effect sizes are not only smaller in magnitude but in some cases, point to the opposite direction. For example, psychometric HR individuals scoring high on the positive dimension reported lower PA and higher NA than controls in response to pleasant stimuli, but the corresponding bipolar effect size showed a higher PA/lower NA (see Figure 6). These differences between bipolar and unipolar scales, together with evidence for an underreporting of heightened state PA, further weaken the overall finding that HR individuals consistently display a state PA deficit. Particularly, in response to pleasant and unpleasant materials, there appears to be a coactivation of both PA and NA, at least for subgroups of HR individuals. Therefore, to afford a clearer understanding of state affective experiences in HR individuals, it behooves future research to use unipolar, rather than bipolar, scales.

Generally speaking, sample and study characteristics predicted the observed affective experience disturbances to a limited extent, often showing weak relations with a specific affective experience category. The more consistent relations are that disturbances, particularly for NA, were weaker for samples with older mean age. It is possible that younger samples are more likely to include participants within the window of peak risk for schizophrenia, therefore having stronger affective experience disturbances. In the absence of participant-level data, however, this finding should be interpreted with caution to avoid committing the ecological fallacy (Greenland & O'Rourke, 2008). Clinical diagnosis status only moderated the trait NA effect size, with individuals with (vs. without) a clinical diagnosis (most commonly, depressive disorders) having a stronger trait NA elevation. Notably, HR individuals without a diagnosis also showed a pronounced trait NA elevation (see Supplemental Table S6). This finding suggests that heightened trait NA may reflect a transdiagnostic vulnerability factor (Horan et al., 2008; Kring & Mote, 2016) and may combine additively to influence the expression of various psychopathologies.

Notably absent from the significant covariates is the use of college samples. Researchers frequently cast doubt on the generalizability of findings based on college students given their potential high-functioning status. Still, college students, in addition to being more accessible for research purposes, are at a critical transition period that coincides with the window of peak risk for schizophrenia and indeed do display clinically meaningful psychotic-like experiences (Cicero et al., 2014). Our findings further buttress the utility of college samples. At least for self-reported affective experiences, college students who are at HR do display disturbances comparable to those ascertained from community and clinical settings.

Collectively, findings illustrate that disturbances in affective experience precede the onset of schizophrenia and are more severe among individuals with higher levels of risk. Therefore, affective experience disturbances may play a contributing role to the development of schizophrenia as opposed to a concomitant or scar of illness onset. In the next section, we situate the meta-analytic findings within the empirical literature and theoretical framework of affective experience disturbances in schizophrenia.

Support for Trait–State Disjunction Across the Schizophrenia Spectrum

The current findings provide strong evidence of continuity in trait impairment across conditions along the schizophrenia spectrum that are characterized by considerably low trait PA and high trait NA. Critically, results demonstrate a discontinuity in state impairment. At the state level, whereas HR individuals largely show an attenuated version of trait disturbances, those affected with schizophrenia display a heightened, stimulus-incongruent state NA with severity on par with trait NA (Cohen & Minor, 2010; Horan et al., 2008). Thus, we may speculate that the transition from HR to schizophrenia is marked by a prominent increase in NA when reacting to materials commonly perceived to be pleasant or otherwise not unpleasant. This pattern could be taken as evidence for the Meehlian proposal of an "aversive drift"—a pervasive developmental progression toward the negative affective tone where things "start out to be fairly rewarding … begin to take on a burdensome, threatening, gloomy, negative emotional charge" (Meehl, 1990, p. 21). Still, to fully explicate the aversive drift concept, longitudinal investigations following HR individuals as they progress through the illness course are needed.

Despite important distinctions, the current finding of a stronger trait than state experience disturbances implies that trait–state disjunction applies to HR individuals. The stimulus-congruent state disturbances observed among HR individuals, although statistically significant, are not dissimilar in magnitude to those observed among individuals with schizophrenia (Cohen & Minor, 2010). Further, there is reason to believe that this difference between affected and HR individuals may be even smaller than observed (e.g., due to underreporting of heightened PA). What might explain the trait–state disjunction manifested across the schizophrenia spectrum? As previously mentioned, one of the theoretical models assigns a central role to the deficient regulatory ability in inhibiting NA (Cohen et al., 2011). While this model could sufficiently explain the disturbances observed for patients with schizophrenia who display heightened NA across trait and state with comparable severity, it does not account for HR individuals' substantially stronger trait (vs. state) NA disturbances. Alternatively, on the basis that people rely on different levels of episodic and semantic knowledge in making trait versus state self-reports (Robinson & Clore, 2002a), an inability to access episodic emotional details contributing to an overreliance on negative semantic beliefs emerges as a better explanatory model. This accessibility account of trait–state disjunction was borne out of findings showing robustly compromised episodic memory in patient and HR populations and has been discussed at length in many previous reviews (Cohen et al., 2011; Kring & Elis, 2013; Strauss & Gold, 2012). Here, we highlight two important details that haven't been enumerated before but are useful for explaining trait–state disjunction in the schizophrenia spectrum.

First, although episodic details are preferentially used whenever available, all reports of affective experience—both trait and state—tap into some degree of semantic beliefs. Indeed, there is evidence that all human mental states, as basic as perception, are predicated on the ratio of top-down (e.g., semantic beliefs) versus bottom-up (e.g., episodic details) processing (Bar, 2021; Herz et al., 2020). It is possible that individuals with, or at risk for, schizophrenia have a greater top-down versus bottom-up ratio that is compounded with episodic memory deficits. This way, induced state affective experiences even when rated in the presence of eliciting materials are expected to produce heightened NA, which is precisely what we observed. Nevertheless, reports on noncurrent experiences (e.g., retrospective, trait, prospective, and hypothetical) are more vulnerable to top-down influences. Especially for prospective and hypothetical reports, episodic details are sorely lacking, so top-down influences would be more apparent than retrospective ones (Robinson & Clore, 2002a). In line with this idea, our results showed that trait pleasure deficits were stronger for anticipatory than consummatory reports.

Second, the accessibility model, or broadly speaking, the ratio of top-down versus bottom-up processing, is a domain-general framework that has been extensively employed to explain various social, cognitive, and affective phenomena (e.g., why gender and cultural stereotypes are primarily observed in trait reports). This opens up a wide array of testable hypotheses and experimental paradigms that can be extrapolated to investigate affective experience disturbances in the schizophrenia spectrum. For example, the diverse mental states underpinned by an overarching top-down versus bottom-up ratio are thought to be interdependent (Herz et al., 2020). Therefore, reducing top-down influences on affect may correspondingly broaden attention and perception as well as induce more exploratory (as opposed to withdrawn) behaviors. It is possible that theoretically and clinically valuable progress can be gained from testing these predictions.

Limitations and Future Directions

Findings of the current meta-analysis should be considered within the confines of its limitations, six of which warrant particular attention. First, although we adopted a spectrum conceptualization of schizophrenia that is informed by current models (Kotov et al., 2020; Kwapil & Barrantes-Vidal, 2015), we are nonetheless limited to the three main HR conditions (i.e., FHR, HR trait, and CHR) as categorically defined. We believe that these three categorical HR approaches provide a useful framework for synthesizing findings that would have the greatest practical implications, given that (a) the three HR approaches are well established in research and clinical practice (Lenzenweger, 2021; Phillips & Seidman, 2008) and (b) only 28 (15.47%) of the included studies reported, or provided data to calculate, an association between affective experience and dimensional measures of risk. Still, we situated the categorical HR conditions along a severity gradient following our spectrum conceptualization; future research is needed to examine whether the current findings are consistent with more dimensional measures of risk.

Second, it is worth noting that there exist sizable differences in the HR criteria within each approach. For example, an individual considered as at CHR can meet one of the three criteria that are assessed somewhat differently across instruments (Fusar-Poli et al., 2013, 2016). In addition, there are no established criteria for determining psychometric HR status, and studies vary in their use of HR cutoffs. Relatedly, we are limited in establishing specificity for schizophrenia-spectrum pathology, as HR individuals commonly have elevated depressive and anxiety symptoms. Although we found evidence that affective experience disturbances were largely independent of clinical diagnosis, predominately consisting of depressive disorders, we cannot rule out the influence of subclinical depressive and anxiety symptoms. We believe that whereas some aspects of affective experience disturbances may represent a nonspecific vulnerability to a wide range of psychopathologies (e.g., high trait NA), there are still disturbances that are more specific to the development of schizophrenia-spectrum disorders (e.g., trait–state disjunction). Future work is clearly warranted to further elucidate whether trait–state disjunction is specific to schizophrenia-spectrum pathology, such as employing longitudinal design or psychiatric control groups.

Third, as studies primarily came from high-income, Western countries, it is possible that the meta-analytic findings may not generalize to non-Western countries. Similarly, we are underpowered to examine several moderator categories due to their low availability in the literature, including rating referenced to the induction stimulus and certain HR approaches. This issue is particularly apparent for the psychometric HR disorganized approach, which was only examined in two studies on trait affect. It should be noted that a single reviewer screened the reports for eligibility, which has been shown to miss more relevant studies than dual reviews (Gartlehner et al., 2020). Nevertheless, considerable, complementary efforts have been made to ensure the exhaustiveness of the review that included 181 independent studies. We thus take the lack of available data as evidence for a gap in knowledge on affective experiences for HR individuals from non-Western nations as well as those with elevated disorganized symptoms.

Fourth, our comparison of state affective experiences across different stimulus types was not as fine-grained as it ideally would have been. Because of the diversity of stimuli used to elicit emotional experiences across studies and the subsequent low number of studies for each stimulus type, we collapsed across fairly distinct types into the "other" category, which might have missed important differences. Further, our examination of stimulus types focused only on the procedural aspect rather than the content (e.g., social vs. nonsocial stimuli). Given our finding of a pronounced social-related deficit in trait PA, it would be important for future work to investigate whether state PA experiences are particularly impaired in response to social stimuli.

Fifth, we focused on self-reported affective valence because it is the most widely studied dimension of affective experience. This is not to say, however, that other dimensions of affective experience (e.g., arousal) and other components of affect (e.g., physiology and behavior) are unimportant or that findings on the valence of affective experience would apply to others (indeed, there are indications that they do not; Cohen et al., 2017; Li, Karcher, et al., 2019). As a result, it would be valuable for future research to discern similarities and differences between different dimensions and components of affect among HR individuals. We hope to have provided a useful point of reference for such work.

Last, but certainly not least, the amount of variation in many of the affective experience effect sizes—often even after accounting for the collection of covariates and moderators—deserves both caution and consideration. While we expected considerable heterogeneity given that the conflicting findings it reflects are among the main reasons for conducting this—or any—meta-analysis, this heterogeneity reduces trustworthiness in average effect sizes (Greenland & O'Rourke, 2008) and likely signals that there are several meaningful moderators beyond those we could code and analyze in the primary studies. With that caution in mind, average effect sizes could still offer tentative recommendations for future research as they may provide more accurate power analysis estimates than conventional benchmarks. This is perhaps especially important in light of the resource-intensive nature of recruiting HR individuals. However, more research is needed to refine moderators examined in this meta-analysis and identify new moderators to further explain this heterogeneity, particularly ones relating to HR approaches that would be useful for both research and practice. This goal of identifying clinically significant moderators in future research serves as a way to both frame and evaluate it, setting a standard that new moderators explain not only a statistically significant proportion of variation but a practically meaningful amount of it (Lipsey et al., 2012).

Conclusions

This meta-analysis represents the most comprehensive synthesis to date of self-reported affective experience disturbances among HR individuals in the schizophrenia spectrum. Based on its findings, we offer the following general conclusions: (a) HR individuals' NA is robustly heightened whereas PA deficits are more nuanced, (b) trait–state disjunction manifests at the HR stage and could be explained by the accessibility model, and (c) the degree of disturbances tracks levels of schizophrenia-spectrum risk. Findings suggest that disturbances in affective experience may be implicated in the etiological pathway toward schizophrenia, but our understanding is far from complete. Particularly, the substantial amount of heterogeneity observed in this meta-analysis reflects a lack of understanding as well as much knowledge to be gained on this topic. We believe that continued investigation on lesser understood areas highlighted in this review (e.g., the disorganized dimension) would be a fruitful direction for future research, as would an attempt to uncover other practically significant moderators beyond those tested in this meta-analytic review.

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