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Using the experience sampling methodology to measure anhedonia and its correlates in mental health research: A systematic review

Joanne R. Beames [a,*], Lotte Uyttebroek [a], Clementine J. Edwards [b,c], Gudrun V. Eisele [a], Nian D.F. Kemme [a], Olivia Collier [b], Eeske van Roekel [d,e], Thomas R. Kwapil [f], Olivia J. Kirtley [a], Inez Myin-Germeys [a]

[a] Department of Neuroscience, Research Group Psychiatry, Center for Contextual Psychiatry, KU Leuven, Leuven, Belgium
[b] Department of Psychology, Institute of Psychiatry, Psychology & Neuroscience, King's College London, United Kingdom
[c] South London & Maudsley NHS Foundation Trust, United Kingdom
[d] Department of Developmental Psychology, Tilburg University, the Netherlands
[e] Tilburg Experience Sampling Center, Tilburg University, the Netherlands
[f] Department of Psychology, University of Illinois at Urbana-Champaign, Champaign, IL, United States of America

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ABSTRACT

Anhedonia is a lack or loss of pleasure in daily life. This is the first systematic review to investigate anhedonia in mental health research with a focus on experience sampling methodology (ESM). The review aimed to identify how anhedonia is conceptualized and measured in ESM research, how it is experienced during daily life, and the quality of reporting in the published literature. To generate a comprehensive picture of anhedonia, we also examined associations between time-invariant measures of anhedonia and other affective, cognitive, and behavioral processes assessed via ESM. We searched PsychARTICLES, MEDLINE, Psychology Databases, EMBASE, Web of Science Core Collection, and Europe PMC (last search 6th January 2025). We identified 113 relevant articles. Anhedonia was typically conceptualized as diminished pleasure, enjoyment, or liking, with emphasis on consummatory rather than anticipatory experiences. Anticipatory and consummatory anhedonia were present in samples that experienced different mental health conditions or symptoms (between-person) and varied across daily contexts and time (within-person). Daily life correlates of anhedonia included increased negative affect, decreased positive affect, affect prediction biases, and social processes. Most studies explored anhedonia in depression or psychotic disorders, although measurement was heterogeneous, and compliance with a reporting quality assessment tool for ESM studies was generally low. This review demonstrates that using ESM to measure anhedonia in mental health research is critical to identify how and when it is experienced in daily life. Future anhedonia research would benefit from using a transdiagnostic perspective, standardized and validated ESM items, exploration of moment-to-moment changes over shorter time-scales, and increased transparency in methodological reporting.

1. Introduction

Anhedonia has been traditionally defined as markedly diminished interest or pleasure in formerly enjoyable activities (American Psychiatric Association, 2022). Considerable research from behavioral neuroscience has indicated that anhedonia is more complex, however, and is underpinned by deficits in reward processes or positive valence systems (Insel et al., 2010; Kieslich et al., 2022; Pizzagalli, 2022a; Rømer Thomsen et al., 2015). These various facets of reward processing can be summarized into two broad concepts: *anticipatory anhedonia*, which refers to a reduced ability to experience pleasure in anticipation of rewarding events, and *consummatory anhedonia*, which refers to a reduced ability to experience pleasure from activities in-the-moment (Ho & Sommers, 2013; Serretti, 2023; Treadway & Zald, 2011; Winer et al., 2019). Anhedonia is a transdiagnostic symptom and risk factor that cuts across traditional diagnostic boundaries (Naguy, Alwetayan, & AlKhadhari, 2020; Guineau et al., 2023); it has been documented in depressive disorders, bipolar disorders, schizophrenia-spectrum

* Corresponding author at: Center for Contextual Psychiatry, Herestraat 49, (ON5b), 3000 Leuven.
E-mail address: joanne.beames@kuleuven.be (J.R. Beames).

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disorders, anxiety disorders, and post-traumatic stress disorders (Craske et al., 2016; Pizzagalli, 2022b). Anhedonia is a robust predictor of poor prognosis, treatment response, and suicide risk (Craske et al., 2016; Gillissie et al., 2023; McMakin et al., 2012; Pizzagalli, 2022b; Whitton et al., 2023), and yet, despite significant research interest, the subjective experience of anhedonia in daily life remains poorly understood and undertreated. Conventional psychological treatments have modest effects on enhancing positive emotions and experiences (Craske et al., 2024). Advancing understanding of anhedonia in daily life is therefore important to to minimize the disease burden associated with a range of mental health disorders.

There are various clinical features of anhedonia. Anticipatory anhedonia, similar to wanting or incentive salience (Berridge & Robinson, 2003), can involve difficulty imagining future pleasureable activities, reduced motivation to engage in pleasurable activities (i.e., motivational anhedonia) (Treadway & Zald, 2011), and a lack of enthusiasm, enjoyment, or excitement for future events (Serretti, 2023). Consummatory anhedonia, similar to liking or hedonic impact (Berridge & Robinson, 2003), can involve difficulty experiencing positive emotions during rewarding events, reduced enjoyment, and less frequent engagement in pleasurable activities (Serretti, 2023). Further, anhedonia can vary across different stimuli or contexts and can be experienced as a state-like or trait-like phenomenon. Most research has focused on social anhedonia, a lack of pleasure in social interactions, and physical anhedonia, a lack of pleasure from sensory and physiological experiences such as sex and eating (Ho & Sommers, 2013; Winer et al., 2019). These experiences can be episodic, worsening during acute phases of a disorder and easing after recovery, or be more persistent and pervasive, indicating a general impairment in experiencing pleasure (Gandhi et al., 2022; Serretti, 2023). Anhedonia is therefore a multifaceted construct with different temporal and contextual features that influence its experience and clinical presentation.

The clinical features of anhedonia have largely been assessed with retrospective self-report measures in cross-sectional observational designs. These studies demonstrate heightened consummatory anhedonia in major depressive disorder, bipolar disorder, schizophrenia-spectrum disorders (including early psychosis), anxiety disorders, post-traumatic stress disorder, and obsessive-compulsive disorder (Krzyzanowski et al., 2022; Pizzagalli, 2022b; Trøstheim et al., 2020; Visser et al., 2020). Other studies have attempted to differentiate between anticipatory and consummatory anhedonia, as well as the experience of anhedonia in different domains (e.g., social, physical). Findings from recent meta-analyses show that anticipatory and consummatory anhedonia are elevated in depression and schizophrenia-spectrum disorders compared to healthy controls (Krzyzanowski et al., 2022; Visser et al., 2020). However, there is limited evidence that there are consistent self-reported differences between consummatory and anticipatory anhedonia, or between social and physical anhedonia, within both disorders (Gandhi et al., 2022; Krzyzanowski et al., 2022; Visser et al., 2020). There are also mixed results for the trait-state distinction. For example, anhedonia can include both state and trait components in major depressive disorder, early psychosis, and schizophrenia (Barkus, 2021; Pelizza et al., 2021; Pelizza & Ferrari, 2009; Serretti, 2023; Whitton & Pizzagalli, 2022), with some evidence that social anhedonia might be more trait-like (Barkus & Badcock, 2019). While this body of research has advanced understanding of the clinical features of anhedonia, there are limitations. Few studies explore anticipatory and social anhedonia outside of early psychosis and schizophrenia-spectrum disorders, and most retrospectively assess hypothetical or imagined scenarios over long periods (e.g., weeks, months) without examining longitudinal changes. This approach is subject to memory biases, lacks the temporal granularity needed to capture changes across shorter timeframes, and does not consider experiences within naturalistic settings.

1.1. Experience sampling methodology

Ambulatory assessment methods such as experience sampling methodology (ESM), otherwise known as Ecological Momentary Assessment (EMA) (Larson & Csikszentmihalyi, 1983; Myin-Germeys et al., 2018; Myin-Germeys & Kuppens, 2022), can address the limitations of retrospective self-reports in anhedonia research. ESM data is typically collected on a smartphone or wearable device, which prompts participants to report mood, symptoms, context, and/or appraisals multiple times throughout the day for multiple consecutive days (Myin-Germeys et al., 2018). This highly ecologically valid method allows near real-time data collection during the flow of daily life, minimizing retrospective biases and providing temporally detailed insights into individual experiences (Myin-Germeys et al., 2018). Overall, ESM can provide critical information about how and when an individual experiences anhedonia in everyday contexts and holds promise for reconciling mixed findings from the extant literature.

ESM has the potential to capture the clinical features of anhedonia, including the temporal (consummatory, anticipatory) and contextual (social, physical) components. ESM can determine whether daily life contexts or natural rewards influence pleasure experiences, potentially capturing variation in experiences that retrospective questionnaires assessed at one point in time are unable to identify. Relatedly, ESM can develop a more fine-grained picture of the timescales during which pleasure can be observed (e.g., across minutes, hours, days, weeks). ESM can also disentangle between-person differences (e.g., whether mean levels of daily life anhedonia differ between depressed and non-depressed individuals), within-person differences (e.g., whether an individual's mean level of daily life anhedonia are higher in moments when with others compared to when alone), and between-person differences in within-person associations (e.g., whether depressed individuals experience higher anhedonia in moments when with others compared to being alone than non-depressed individuals). Differentiating these sources of variability is critical to understand how the experience of anhedonia unfolds in daily life for different individuals. Further, ESM can examine contemporaneous and temporal links between anticipatory and consummatory anhedonia, to identify how these components influence each other to drive emotional experience and behavior in daily life. Understanding the dynamics of anhedonia in context is important because it can help explain why an individual is not engaging in certain behaviors – it could be because they do not anticipate pleasure in the future or because they do not experience in-the moment pleasure in specific contexts.

1.2. The research gaps

The application of ESM in anhedonia research has burgeoned over the past decade, although there are several gaps in the available literature. First, there is no consensus on how to conceptualize and measure anhedonia in daily life using ESM and there is a lack of knowledge about how measurement decisions impact findings. Second, it is unclear who experiences anhedonia in daily life across the mental health spectrum (i.e., between-person) and when it is experienced in daily life (i.e., within-person). It is important to identify how anhedonia manifests in daily life across the mental health spectrum given its status as a transdiagnostic symptom (and risk factor) throughout the lifespan. There are many open questions about the experience of anhedonia across various disorders (e.g., depression, anxiety, bipolar) and across different stages of mental health (e.g., healthy, sub-clinical, clinical). Third, the quality of reporting in existing ESM studies is unclear. Assessing quality of reporting is necessary to contextualize the results from ESM studies and to identify potential focus areas to improve the evidence-base of anhedonia in the future. For example, a recent review of interpersonal processes and their measurement within ESM studies of self-injurious thoughts and behaviors found that most studies did not report critical methodological information about the ESM protocol, data analysis, and

results (Janssens et al., 2024). Another key finding was that the ESM studies largely used inconsistent operationalizations of interpersonal processes, and methodological differences between studies precluded firm conclusions about within- and between-person effects (Janssens et al., 2024). A comprehensive systematic review of ESM literature on anhedonia is the next step to clarify outstanding gaps relating to measurement, everyday subjective experience, and quality of existing studies.

1.3. The current systematic review

The current systematic review aims to answer: 1) How is anhedonia conceptualized and explicitly measured using ESM in mental health research?; 2) What is the experience of anhedonia in daily life at the between-person level and at the within-person level?; and 3) What is the quality of reporting in ESM studies assessing anhedonia in daily life? We used a narrative review approach, as opposed to a quantitative approach (e.g., meta-analysis), given the nature of the research questions, the anticipated heterogeneity of methods, and the complexity of estimating standardized effect sizes from models that account for the multilevel structure of ESM data (Rights & Sterba, 2019).

2. Method

2.1. Transparency and openness

The protocol for this systematic review was prospectively registered using the Non-Interventional, Reproducible and Open Systematic Reviews (NIRO-SR) template (Topor et al., 2022) on the Open Science Framework (OSF) on 9th June 2023 (https://osf.io/6gc8x/?view_only=b00f80281ba540bdbd2cc1f93105c12f). All study materials, including the screening manual and decision log, data extraction form, and reporting quality assessment tool are accessible on the OSF project page (https://osf.io/bm9hc/?view_only=47c64e69b6bd43c38784ee7fb47f9506). Minor deviations to the registration plan pertaining to the research questions, selection criteria, and search strategy are also recorded on the OSF project. Criteria and decision rules were refined to allow transparency and replicability of the screening process, and we did not contact corresponding authors of included articles to query additional outputs given the breadth of search results. We report our methodological approach and findings in accordance with the updated Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Page et al., 2021). All data are described in text and are presented in tables in the online Supplementary Material.

2.2. Eligibility criteria

Studies of all designs and samples were included if they used ESM (defined as an intensive longitudinal data collection method that also encompassed daily diaries) and explicitly assessed self-reported anhedonia in daily life using ESM. Explicit assessment of anhedonia required that: 1) ESM items were operationalized as measuring anhedonia, including hedonic and reward-related experiences; or 2) ESM items were evaluated in relation to time-invariant measures of anhedonia assessed at baseline (e.g., trait symptom measures, clinician-rated diagnostic interviews). The former criterion encompassed studies that directly measured momentary experiences of anhedonia in daily life; the second criterion encompassed studies that measured other momentary symptoms or experiences (e.g., affective, cognitive, or behavioral correlates) to characterize the daily lives of individuals with anhedonia. Hedonic and reward-related experiences included, but were not limited to, pleasure, positive affect, interest, liking, wanting, future anticipation of pleasure, and motivation to seek out pleasurable experiences. These experiences captured both consummatory (i.e., in-the-moment) and anticipatory (i.e., in-the-future) components of anhedonia, and occurred in any domain (e.g., social, physical). These experiences were broadly guided by existing conceptual models of anhedonia and reward-related processes (e.g., (Ho & Sommers, 2013; Kring & Barch, 2014; Rizvi et al., 2016; Winer et al., 2019)). Further, given that we were interested in anhedonia from a transdiagnostic perspective, we included samples regardless of mental health condition (e.g., depression, schizophrenia) or severity/stage (e.g., sub-clinical, clinical). We also included healthy samples because anhedonia can occur in the general population (Trøstheim et al., 2020) and may serve as an early risk factor for the later development of mental health disorders (Pizzagalli, 2022b).

Studies were excluded if they did not include ESM; if they explored components of hedonic or reward-related experiences via ESM without an explicit link to anhedonia (e.g., ESM studies that measured positive affect dynamics, mood reactivity, emotional uplifts, or processes underpinning anhedonia such as reward learning, but did not specifically link these constructs to anhedonia); if they primarily explored anhedonia within the context of physical health problems, drug and alcohol problems, other neurological/medical conditions, or other fields not related to mental health; if they primarily explored statistical or methodological techniques; and if they were not empirical, not published in a peer-reviewed journal (with the exception of preprints), or not published in the English language. Intervention studies were also excluded if they did not include a psychological/mental health intervention designed to shift the way an individual thinks, feels and/or behaves by developing new knowledge and skills. Note that there were no exclusion criteria pertaining to the number of beeps per day, the duration of the ESM period, or sample characteristics (e.g., mental health condition/severity). There were also no exclusion criteria for study design; for example, psychological intervention or neuroimaging studies were included if they included ESM.

2.3. Information sources

We conducted a systematic database search of PsychARTICLES (via ProQuest), MEDLINE (via ProQuest), Psychology Databases (via ProQuest), EMBASE (via Elsevier), Web of Science Core Collection (via Clarivate), and Europe PMC. Europe PMC was used to search for preprints in addition to peer-reviewed publications. These databases were selected because they appropriately cover psychiatry, psychology, and mental health research. The original database search was conducted on 31st May 2023 and was re-updated on 6th January 2025.

2.4. Search strategy

The key concepts of the systematic search strategy were anhedonia and the use of the experience sampling method. The search terms included a combination of keywords and Medical Subject Heading (MeSH) terms and were adapted to meet the requirements of each database. The quality of the search strategy was maximized by generating search terms through consultation with an internal expert in conducting systematic reviews and through peer-review with co-authors (JRB, OJK) involved during the planning stage of the review. Scoping searches were then conducted to validate the selected terms, which involved cross-checking search results to identify a set of benchmark titles. No limits were imposed on the search. We also scanned the reference lists of all included articles to obtain relevant studies not identified in the original search. See Supplementary Material A for full database search terms and benchmark titles.

2.5. Selection process

In stage 1, four independent reviewers (JRB, LU, NDFK, CJE) screened titles and abstracts to assess relevance based on inclusion criteria (JRB screened 100 %, LU and NDFK double screened approximately 45 % each, CJE double screened approximately 10 %). In stage 2, full texts of the potentially eligible papers were then retrieved and independently assessed against the inclusion criteria by the same

reviewers in stage 1. Studies that did not meet the inclusion criteria were excluded. Inter-rater reliability for full text screening was $k = 0.72$ for rater 1 (JRB) and rater 2 (LU) and $k = 0.71$ for rater 1 and rater 3 (NDFK). Although most discrepancies ($n = 27$) were resolved through discussion with the original raters, 10 could not be resolved and were screened by a third independent reviewer who had specialist knowledge in ESM and anhedonia (CJE). Discrepancies, discussions, and resolutions were recorded in a decision log in excel; full-text screening decisions were also recorded along with reasons for exclusions. Reviewers used separate Endnote management files and decision logs, both with restricted accessibility, to ensure blinding of decisions.

2.6. Data extraction

JRB extracted the data and recorded it in a Microsoft Excel Spreadsheet. A smaller random subset of extracted data (25 %) was checked independently by LU for consistency and clarity. There were no discrepancies. To summarize the included studies, we extracted study characteristics, sample characteristics, ESM protocol details, and open science practices. As main outcomes, we extracted details relating to anhedonia measurement (e.g., ESM items) and a brief description of the results. See Supplementary Material A for a comprehensive list of extracted data and decision rules.

2.7. Quality and risk of bias

Quality of reporting in included studies was assessed using a composite quality assessment tool for ESM studies developed within the Center for Contextual Psychiatry (Janssens et al., 2024). The tool is adapted from Liao, Skelton (Liao et al., 2016) and Trull and Ebner-Priemer (Trull & Ebner-Priemer, 2020) and is available at https://osf.io/dxvsh/?view_only=14369f50061241f19ac0c6b67e4d71e8. Studies were assessed based on the technical details and justifications provided for ESM design choices in each section of the manuscript: (1) Title/abstract (specification of study as ESM); (2) introduction (rationale for ESM); (3) methods (e.g., ESM training, compliance, sampling design); (4) results (e.g., clear description of data, number of ESM prompts sent and delivered); (5) discussion (ESM specific limitations); and (6) transparency and reproducibility (e.g., pre- or post-registration, open materials/code/data). Four independent reviewers (JRB, GVE, NDFK, OC) assessed the reporting quality of included studies. JRB and OC double-coded a random sample of 30 articles (26.55 %) for consistency, and uncertainties were resolved through discussion with JRB.

2.8. Synthesis methods

We used a narrative synthesis to report key characteristics of studies pertaining to the design, sample, open science practices, and ESM protocol. We then reported specific ESM measures used to capture anhedonia in daily life. To synthesize the data, we categorized the relevant ESM variables in three ways. First, we identified the main component of anhedonia encapsulated by the ESM items and the computed variables (e.g., pleasure, liking, reward). Second, we identified whether the items were related to specific events or activities (i.e., event anhedonia), social interactions or company (i.e., social anhedonia), or general experiences that were not context-bound (i.e., general experiences of pleasure or interest). Third, we classified the items according to their conceptual focus on consummatory or anticipatory experiences. In the final section, we presented a summary of results from the included studies, organized by anhedonia type and study type. Tables were used to display key data. JRB synthesized the results, with supervision from IMG.

3. Results

3.1. Study selection

See Fig. 1 for the PRISMA diagram illustrating the study selection process and reasons for exclusion. A total of 6594 articles were identified from the database search, from which 1893 duplicates were removed. Of the remaining 4701 articles, 4433 were excluded during title and abstract screening. Two full-texts could not be retrieved, leaving 266 articles for full-text screening; 160 were excluded because they did not meet the inclusion criteria. Seven additional articles were included after a manual search of reference lists, resulting in 113 studies in the current review.

3.2. Study and sample characteristics

See Table S1 in Supplementary Material B for detailed study and sample characteristics. The median year of publication was 2021 (range = 2007–2025). Studies primarily used prospective longitudinal observational designs ($n = 100$, 88.50 %) and were conducted in the United States ($n = 61$, 53.98 %). About half of the included studies ($n = 58$, 51.33 %) reported using original data, with 46 (40.71 %) conducting secondary analyses on existing datasets.[1]

Most studies did not use a transdiagnostic approach ($n = 86$, 76.11 %); most explored anhedonia in the context of depression ($n = 47$, 41.59 %) and psychotic disorders including schizophrenia-spectrum disorders and early-stage psychosis ($n = 40$, 35.40 %). Relatively few studies explored anhedonia in the context of anxiety ($n = 15$, 13.27 %), bipolar ($n = 5$, 4.42 %), borderline personality ($n = 1$, 0.88 %), or other conditions such as sleep or suicidal ideation ($n = 14$, 12.39 %). Similarly, few studies explored anhedonia independent of other mental health symptoms or diagnoses ($n = 18$, 17.65 %). Most studies used adult samples (>25 years; $n = 64$, 56.64 %), reflecting the mean age ($M = 29.4$, $SD = 7.0$, range = 14.20–56.90) of all studies included in the review. Participants were predominantly female ($M = 64.70$ %, range = 7.77–100 %) and identified as Caucasian or White ($n = 55$, 48.67 %), although ethnicity was often not reported ($n = 46$, 40.71 %). The average analyzed sample size was 129.04 (range = 3–1368).

3.3. Experience sampling protocol

See Table S2 in Supplementary Material B for details of the ESM device and sampling protocol. Most studies used a smartphone ($n = 71$, 62.83 %) for data collection and devices were typically provided by the research team ($n = 44$, 38.94 %). Most ESM protocols involved signal-contingent sampling ($n = 94$, 83.19 %), meaning that participants received a notification (or "beep") each time they were required to complete a survey. These beeps were typically delivered randomly within pre-specified intervals each day (i.e., semi-randomly; $n = 53$, 56.38 %). The modal ESM data collection duration was 1 week, with a minimum of 2 days and a maximum of 464 days ($M = 3.84$ weeks, $SD = 8.66$), and most studies signaled participants 3–4 times per day ($n = 37$, 32.74 %) or 7–10 times per day ($n = 44$, 38.94 %). The average number of beeps per day was 5.8 ($SD = 3.2$). Of the studies that reported compliance ($n = 72$, 63.72 %), the average rate was 76.56 % (range = 48.57–95.60 %).

3.4. How is anhedonia conceptualized and explicitly measured using ESM (RQ1)?

See Tables S3-S7 for detailed measurement information, including

[1] Some datasets were used multiple times, for example, the No Fun No Glory dataset was used in seven studies. All studies, regardless of data re-use, are included in the descriptive characteristics reported in this review.

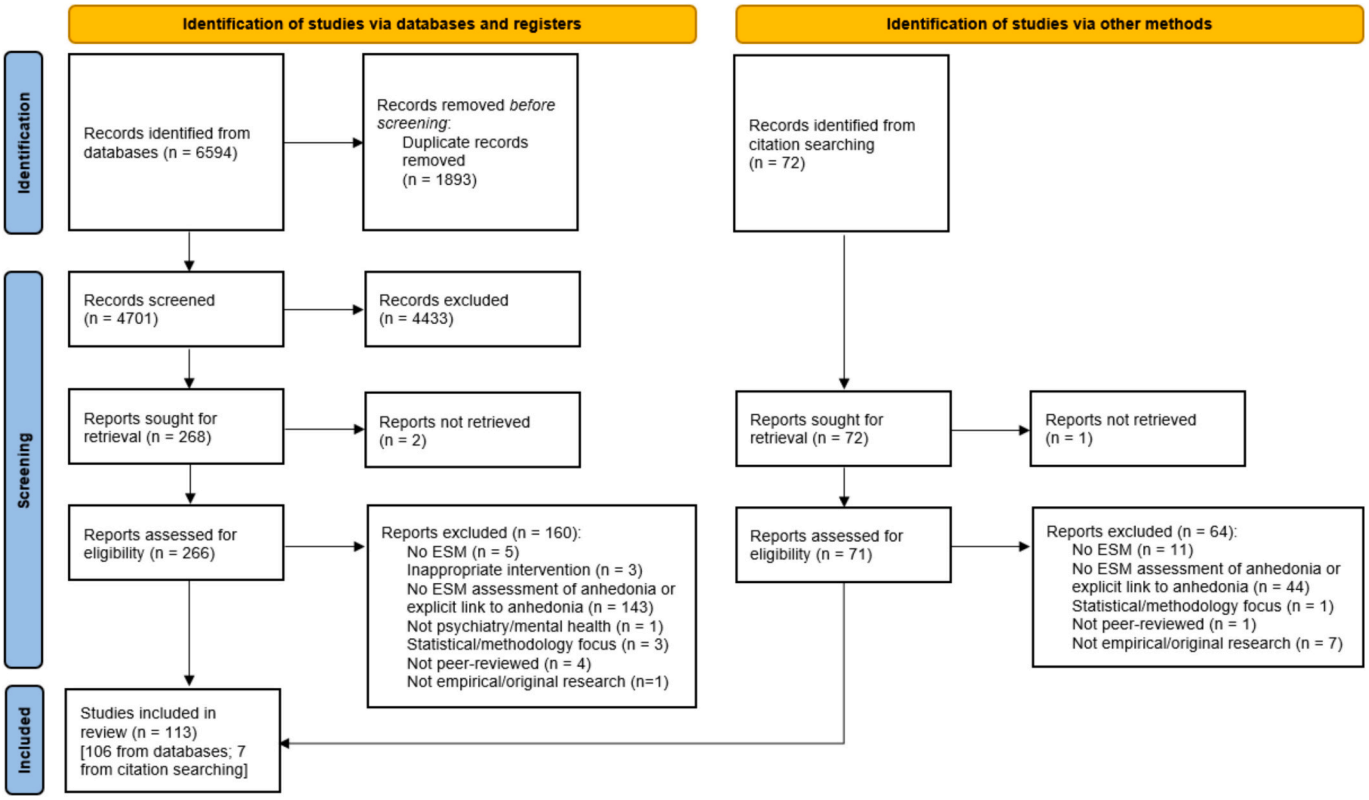

Fig. 1. PRISMA 2020 flow diagram of the search.

ESM scale types, items, response options, timescales, and operationalizations (also see Supplementary Material C for additional results). Most studies investigated momentary experiences of anhedonia in daily life, whereby anhedonia was measured at the within-person level via ESM (n = 77, 68.14 %); 16 (14.16 %) studies investigated emotional, cognitive, and/or behavioral momentary experiences associated with baseline anhedonia, which was measured at the between-person level via standardized and validated retrospective questionnaires or clinical interviews. Twenty (17.70 %) studies measured anhedonia using both ESM and retrospective questionnaires.

3.4.1. *Momentary experiences of anhedonia in daily life*

Most studies operationalized anhedonia in terms of pleasure, interest, enjoyment, or liking (n = 68, 70.10 %), followed by positive affect reactivity (n = 15, 15.46 %) and reward-related experiences (n = 11, 11.34 %). Other studies examined positive affect (n = 6, 6.19 %), anhedonic depression (n = 4, 3.09), hedonic experience during activities (n = 1, 1.03 %), and/or social affective forecasting (n = 3, 3.09). There was considerable variation in operationalization when items assessed the same anhedonia construct or similar aspects of the same construct. For example, there was little overlap in the items used to assess pleasure, enjoyment and liking across different studies. Further, in line with the definition of anhedonia, 35 (36.08 %) studies framed ESM items in terms of a reduction or loss of pleasure, or reverse coded positively framed items such that higher pleasure was recoded to higher anhedonia. Most studies did not report the source of ESM items used (n = 41, 42.27 %); of those that did, most used newly created ESM items or ESM items adapted from prior studies (n = 28, 28.87 %). Explanations of each construct, along with example ESM items, are presented in Table 1.

Most studies either explored anhedonia in relation to an event or activity (n = 58, 59.79 %), or assessed anhedonia in general without specifying a particular context (n = 44, 45.36 %). Fewer studies assessed anhedonia during social events (i.e., social anhedonia; n = 26, 26.80 %). Almost all studies investigated consummatory anhedonia (n = 94, 96.91 %) and 42 studies (43.30 %) investigated anticipatory anhedonia. Note that for anticipatory anhedonia, most studies used ESM items that assessed looking forward to a future event or expected pleasure from a future event (n = 40, 95.24 %), rather than current pleasure experienced in anticipation of future pleasant events (n = 2, 4.76 %). Approximately 40 % (n = 39) of studies assessed both consummatory and anticipatory anhedonia.

There was variation in how momentary anhedonia was conceptualized and measured across the mental health spectrum. In depression, the focus was primarily on general experiences (n = 30, 69.77 %) and/or event anhedonia (n = 17, 39.53 %), with only one (2.33 %) including ESM items on social anhedonia. All depression studies focused on consummatory anhedonia (n = 43, 100 %), 10 (23.36 %) of which also explored anticipatory anhedonia. A similar pattern of results was found for anxiety, with most studies examining general (n = 10, 90.91 %) and consummatory (n = 11, 100 %) anhedonia. All studies that explored anhedonia in psychotic disorders or psychosis focused on context-bound experiences of anhedonia (event and/or social anhedonia) (n = 35, 100 %). Most of these studies explored consummatory (n = 33, 94.29 %) and/or anticipatory anhedonia (n = 24, 68.57 %). All studies that used a transdiagnostic lens assessed consummatory anhedonia (n = 22, 100 %), three (13.64 %) of which also included anticipatory anhedonia. See Table 2 for an overview of items categorized by context (context-specific versus general), temporality (consummatory versus anticipatory), and mental health symptoms or diagnoses.

3.5. *What is the experience of anhedonia in daily life at the between-person level and at the within-person level (RQ2)?*

This section focuses on the 97 studies that measured momentary experiences of anhedonia using ESM (see Table 3 for a summary of results). Findings are organized by observational studies assessing anticipatory and consummatory anhedonia, followed by intervention studies. Note that eleven studies averaged across anticipatory and

Table 1
Explanations of each anhedonia construct with example ESM items.

Construct	Explanation	Examples
Pleasure, interest, enjoyment, or liking	Momentary experiences of pleasure, interest (including indifference), enjoyment, or liking. Also encapsulates other emotions ostensibly related to pleasure and enjoyment, such as happiness, pleasantness, and feeling good. Note that some studies ($n = 11$) assessed pleasure and interest together in the same item; only 7 studies assessed interest independently	1. *"I am enthusiastic and feel pleasure"* (Baryshnikov et al., 2023) 2. *"How difficult is it right now to enjoy activities?"* (Brown et al., 2011) 3. *"How interested have you been in what you have been doing?"* (Dejonckheere et al., 2021) 4. *"In the past 4 h, I have had little interest or pleasure in doing things"* (Gallagher et al., 2025)
Positive affect reactivity	Momentary experiences of positive affect in response to specific contexts (often pleasurable contexts)	1. The statistical relationship between event pleasantness (*"Since the last beep, the most important thing that happened to me was pleasant"*) and average of positive affect items (*"I feel happy right now", "I feel relaxed right now", "I feel satisfied right now", "I feel enthusiastic right now"*) (Kwapil et al., 2012)
Reward-related experiences	Diverse experiences relating to reward, including reward prediction error (i.e., the lagged relationship between anticipatory pleasure and later consummatory pleasure) (Bakker et al., 2019), reward network loops (i.e., reciprocal lagged relationships between positive affect, reward anticipation, and active behavior) (Bakker et al., 2017), and reward responsiveness (i.e., experiences of enjoyment, interest, or motivation in contexts defined as personally rewarding) (Fields et al., 2022). Note that there is conceptual overlap between reward responsiveness and positive affect reactivity. For example, in two instances, reward reactivity was modelled as the statistical relationship between an ostensible reward (e.g., activity pleasantness or positive event) and average positive affect (Geschwind et al., 2011; Heininga, Dejonckheere, Houben, Obbels, et al., 2019)	1. Reward prediction error: The statistical relationship between reward anticipation (*"Think about what you consider to be the most important situation in the next hour…"; "How much are you looking forward to this situation?"*) at t-1 and activity pleasantness (*"Think about what you were doing right before the beep-signal…I enjoy doing this"*) at t (Bakker et al., 2019) 2. Reward network loops: Statistically modelled by predicting reward anticipation (see above), behavior (*"I am actively engaged in something"*), and positive affect (average of *"cheerful", "relaxed", "satisfied", "enthusiastic", "energetic"*) at t from the other at t-1 (Bakker et al., 2017)
Positive affect	Momentary experiences of discrete emotions averaged to create an index of positive affect	1. *"In this moment, I feel happy/excited/ relaxed"* (Song et al., 2024) 2. *"To what extent did you feel (emotion):* (1) *happy,* (2) *excited,* (3) *cheerful, and* (4) *content or peaceful?"* (Hawes & Klein, 2024)
Anhedonic depression	Blunted or low levels of positive affect, as well as reduced enjoyment and/or appetitive drive	1. *"Felt like I had a lot to look forward to"* (reverse coded) (Bean & Ciesla, 2021; Kalmbach et al., 2017) 2. *"Felt really happy"* (reverse coded) (Bean & Ciesla, 2021; Kalmbach et al., 2017)
Hedonia	Hedonic experiences during activities	Item not worded (Kluge et al., 2018)
Social affective forecasting	Social affective forecasting involves making predictions about how one will feel during future social events. This concept, also known as bias or accuracy, is conceptually similar to reward prediction error. It is typically measured by comparing pleasure experienced in the moment (consummatory) with the pleasure anticipated beforehand (anticipatory)	1. The absolute value of the difference between anticipatory pleasure (*"Please rate how much you think you will enjoy this activity by moving the slider below"*) and consummatory pleasure (*"Please rate how much you enjoyed the activity by moving the slider below"*) (Abel et al., 2024)

consummatory ESM items to create an overall average index of anhedonia in the moment. Given that we cannot differentiate between the two temporal components in these cases, we report more extensive results in Supplementary Material C. Studies that used machine learning, or explored daily life correlates of time-invariant measures of anhedonia assessed at baseline, are also summarized in Supplementary Material C. In short, daily life correlates of baseline anhedonia included increased negative affect, decreased positive affect, affect-related biases (e.g., underestimating future positive affect) and preferences for solitude; there was no evidence for disturbances in positive affect regulation. In the following section, we group within-person and cross-level interactions together, as the latter provides information about how within-person associations differ across between-person characteristics (e.g., baseline symptoms) (Aguinis & Culpepper, 2015; Viechtbauer, 2022).

3.5.1. *Anticipatory anhedonia*

3.5.1.1. Between-person level. There was converging evidence that mental health condition or symptoms measured at the between-person level were associated with daily life anticipatory anhedonia. Adolescents and young adults with higher depressive symptoms reported lower average levels of reward anticipation (Bakker et al., 2017; Bakker et al., 2019), anticipatory pleasure (Li et al., 2019), and anticipation of positive next-day experiences (Starr & Hershenberg, 2017) than those with lower depressive symptoms. Similar results were found in a study comparing clinically depressed samples to healthy controls (Wu et al., 2017). This study also found that anticipatory pleasure did not differ between depressed individuals with and without comorbid anxiety disorder (Wu et al., 2017). Healthy young adults with higher trait anhedonia (Wieman, Arditte Hall, et al., 2022), higher trait experiential avoidance (i.e., unwillingness to sustain engagement with unwanted internal experiences) (Fields et al., 2023), higher trait negative schizotypy (Kwapil et al., 2020), and adults with first episode psychosis or at clinically high risk (CHR) for psychosis (Gerritsen et al., 2019), also reported lower anticipated reward responsiveness or anticipatory pleasure than those with lower symptoms or healthy controls. Similarly, in healthy young adults, higher trait valued living (i.e., congruence between one's behaviors and values) was positively associated with (Fields et al., 2022), and exposure to a community-stressor (i.e., COVID-19) was negatively associated with (Wieman, Fields, et al., 2022), anticipatory reward responsivity.

More in-depth investigation into anticipatory anhedonia has been conducted in adults with schizophrenia. When examining adults with schizophrenia only, higher negative symptoms (Abel et al., 2024) and depressive symptoms were associated with reduced anticipatory pleasure (Merchant et al., 2022); but when compared to healthy controls, there were no group differences in anticipated pleasure, either during the next two hours (Abel et al., 2024) or for the next day (Shovestul et al., 2022). Several studies have also explored between-person

Table 2
Anhedonia construct by temporality, context and mental health.

Construct	Explanation	Examples	Mental health
Temporality			
Consummatory	Experience of pleasure (or lack thereof) in-the-moment	1. *"I feel some pleasure in what I am doing"* (Thonon et al., *2020*; Thonon, Contreras, & Larøi, 2022; Thonon, Levaux, et al., 2022) 2. *"How much are you enjoying this activity?"* (Edwards et al., 2019; Luther et al., 2023) 3. *"To what extent do you now experience difficulties to enjoy activities?"* (Bogaert et al., 2023)	Commonly assessed in depression, anxiety, and psychotic disorders/ psychosis
Anticipatory	Difficulty anticipating the experience of pleasure in a future enjoyable activity or context	1. *"When you think about the next two hours, how much pleasure do you experience at the thought of doing any of the following activities?* *… being around others and doing joint activities* *… having a meal together…(etc)"* (Pillny et al., 2024) 2. *"How much do you think you will enjoy that activity the next time you do it?"* (Luther et al., 2023)	Commonly assessed in psychotic disorders/ psychosis. Limited assessment in other mental health contexts
Context			
Activity or event	Assessment of anhedonia in relation to a specific activity, behavior, or event experienced in daily life (not including social interactions)	1. *"Since the last prompt, I have been looking forward to some activities or events"* (Thonon et al., 2020; Thonon, Contreras, & Larøi, 2022; Thonon, Levaux, et al., 2022) 2. *"How much are you enjoying the activity?"* (in relation to *"What are you doing right now?"*) (Narkhede et al., 2022)	Commonly assessed in psychotic disorder/ psychosis. Evidence base building for depression
Social	Assessment of anhedonia in relation to social context in daily life, including being in the presence of company or engaging in an interaction	1. The statistical relationship between *"I feel pleasant being in their company"* (in relation to *"Who are you with right now?"*) and positive affect (average of *"I feel cheerful", "I feel satisfied", "I feel enthusiastic", "I feel relaxed"*) (Fung et al., 2023) 2. *"How much are you enjoying the interactions?"* (Mote et al., 2019)	Commonly assessed in psychotic disorder/ psychosis. Limited assessment in other mental health contexts
General	General experiences of pleasure (or lack thereof) without specification of context	1. *"How much pleasure are you having?"* (Ben-Zeev et al., 2012; Ben-Zeev & Young, 2010) 2. *"I am enthusiastic and feel pleasure"* (Baryshnikov et al., 2023)	Commonly assessed in depression

differences in anticipatory pleasure when engaging in specific behaviors. For example, compared to healthy controls, individuals with schizophrenia showed higher anticipatory pleasure for leisure activities, functional activities (Edwards et al., 2018), and pleasurable goal-directed activities (Gard et al., 2014), but lower anticipatory pleasure for goal-directed activities in general (Gard et al., 2007). Another study found that different components of mental imagery were associated with anticipatory pleasure, such that increased use of mental imagery and multisensory vividness were positively associated with state anticipatory pleasure (Pillny et al., 2024).

3.5.1.2. Within-person level and cross-level interactions. Emerging evidence in healthy and early psychosis samples indicated that anticipatory anhedonia varied across specific contexts or behaviors at the within-person level. In healthy young adults, daily indices of poor sleep quality were associated with lower anticipatory reward responsiveness independent of trait anhedonia and sub-clinical depressive symptoms (Wieman, Arditte Hall, et al., 2022). Another study in healthy adults did not find a relationship between daily sleep and anticipatory anhedonia, although anticipatory anhedonia was positively associated with same-day and next-day suicidal thoughts (Patel et al., 2024). State experiential avoidance was not associated with anticipatory reward responsiveness in a similar sample (Fields et al., 2023). For young adults at CHR for psychosis, anticipatory anhedonia was generally higher compared to controls in most activities, locations, and social contexts, although experiences varied across contexts within both groups (Luther et al., 2023). For example, within the CHR group, anticipatory anhedonia was higher when studying or working, eating, running errands, or commuting, but was lower when engaged in recreational activity (compared to resting).

Other studies have examined prospective within-person relationships between anticipatory anhedonia, stress, and other motivational processes in early psychosis and schizophrenia. One study found that increased activity-related stress predicted reduced anticipatory pleasure at the next beep regardless of CHR status (Gerritsen et al., 2019). Another study found that while anticipatory pleasure was important for transforming intentions into goal-directed behaviors at the next beep in social, self-care and recreational domains regardless of clinical status, the lagged association between intentions and pleasure in the social domain was smaller for patients (Pillny et al., 2020). Future anticipation at the current beep also predicted anticipation, motivation, and effort at the next beep in individuals with schizophrenia (Thonon, Contreras, & Larøi, 2022). Similar variables did not predict activity at the next beep in this group, although expectation did predict activity at the next beep in controls (Edwards et al., 2018).

3.5.2. Consummatory anhedonia

3.5.2.1. Between-person level. There was considerable evidence that mental health condition or symptoms measured at the between-person level were associated with daily life consummatory anhedonia.

Table 3
High-level summary of results at the between- and within-person levels.

Construct & level	General pattern of results	Mental health	Age
Anticipatory Anhedonia			
Between-person	1. Mental health condition (diagnosed) or symptoms were associated with increased anticipatory anhedonia in daily life	Depression (& comorbid anxiety), psychosis	Adolescents, young adults, adults
	2. Limited evidence for differences in anticipatory anhedonia between individuals with schizophrenia and healthy controls in general, but there was variation by activity-type and mental imagery	Schizophrenia	Adults
	3. Trait anhedonia, experiential avoidance, and negative schizotypy were positively associated with, and trait valued living was negatively associated with, increased anticipatory anhedonia in daily life	Healthy	Young adults, adults
Within-person	1. Emerging evidence for prospective relationships between sleep, suicidal ideation, and anticipatory anhedonia in daily life	Healthy	Young adults, adults
	2. Activity-related stress important for anticipatory pleasure regardless of clinical status	Psychosis, healthy	Young adults
	3. Emerging evidence that anticipatory anhedonia varies by activity-type	Schizophrenia	Adults
	4. Limited evidence for global anticipatory deficit in schizophrenia; experiences are likely influenced by motivational factors (e.g., effort) and differ across social and non-social domains	Schizophrenia	Adults
Consummatory Anhedonia			
Between-person	1. Mental health condition (diagnosed) or symptoms were associated with increased consummatory anhedonia in daily life.	Depression, anxiety, psychosis, insomnia, schizophrenia	Adolescents, young adults, adults
	2. Consummatory anhedonia varied by activity-type, but there were inconsistent differences between individuals with schizophrenia and healthy controls	Schizophrenia	Adults
	3. Trait anhedonia, experiential avoidance and negative schizotypy were positively associated with, and trait valued living and positive rumination were negatively associated consummatory anhedonia in daily life	Healthy, clinical (for rumination)	Young adults, adults
Within-person	1. Limited evidence for a generalized deficit in reactivity, with sub-clinical and clinical samples able to feel pleasure in both social and non-social contexts	Depression, psychosis, psychotic disorders (incl. schizophrenia)	Young adults, adults
	2. Consummatory anhedonia varied by activity-type, but there were inconsistent differences between samples	Psychosis, schizophrenia, insomnia, anxiety, depression, healthy	Young adults, adults
	3. Emerging evidence for contemporaneous and temporal relationships between anhedonia, stress, sleep, and suicidal ideation	Depression, psychosis, bipolar	Adolescents, young adults, adults
	4. In studies estimating network models, consummatory anhedonia influenced (outstrength) and was influenced by other symptoms (instrength), but there was considerable intra- and inter-individual heterogeneity	Depression, anxiety, borderline personality	Young adults, adults
Associations Between Anticipatory and Consummatory Anhedonia			
Between-person	1. Mixed results for social affective forecasting	Depression, schizophrenia	Adults
Within-person	2. Consistent evidence that anticipatory and consummatory anhedonia are contemporaneously and temporally associated	Depression, schizophrenia, healthy	Adolescents, young adults, adults

Note. The mental health column incorporates sub-clinical symptoms and formal diagnoses.

Adolescents, young adults, and adults with higher depressive symptoms reported lower average levels of activity pleasantness (Bakker et al., 2019), positive affect (Bakker et al., 2017), consummatory pleasure (Li et al., 2019), proportion of pleasant events (van Roekel et al., 2016), pleasure during positive events (van Roekel et al., 2016), pleasantness of important events since the last beep (Brown et al., 2011), and stronger affective bipolarity (i.e., high momentary sadness and anhedonia) (Dejonckheere et al., 2018) than those with lower depressive symptoms. Similar results have been found in clinical young adult and adult samples with depression (Baryshnikov et al., 2023; Hawes & Klein, 2024; Heininga, Dejonckheere, Houben, Obbels, et al., 2019; Song et al., 2024; Thompson et al., 2021; Wu et al., 2017), young adults with depression or anxiety (Berhe et al., 2023), young adults with negative schizotypy (Barrantes-Vidal et al., 2013; Kwapil et al., 2012), adults with early psychosis (Gerritsen et al., 2019), adolescents, young adults, and adults with anhedonia (Heininga et al., 2017; Murray et al., 2022; van Roekel et al., 2016; van Roekel, Heininga, et al., 2019; Wieman, Arditte Hall, et al., 2022), adults with insomnia disorder (Te Lindert et al., 2018), and adults with schizophrenia (Oorschot et al., 2012; Oorschot et al., 2013). In adults with schizophrenia, higher depressive symptoms, but not negative symptoms, were also independently associated with reduced consummatory pleasure (Merchant et al., 2022). However, not all consummatory anhedonia variables were related to schizophrenia symptoms in clinical adult samples (Abel et al., 2024; Kluge et al., 2018; Mote et al., 2019), and there were inconsistent findings across leisure, functional, and social activities (Edwards et al., 2018; Gard et al., 2007; Gard et al., 2014).

Other studies found that anhedonia symptoms were recalled as more severe by adults with depression compared to controls (Ben-Zeev & Young, 2010), and that higher levels of event and social anhedonia in adolescents and young adults with ultra-high risk of psychosis were associated with poorer functioning (Paetzold et al., 2021). Further, trait

valued living (Fields et al., 2022) in healthy young adults and positive rumination (Gallagher et al., 2025) in adults with depression were associated with increased consummatory reward and anhedonia dynamics. There was also evidence in healthy young adults that trait experiential avoidance (Fields et al., 2023) and exposure to COVID-19 were negatively associated with positive affect and consummatory reward (Wieman, Fields, et al., 2022).

3.5.2.2. Within-person level and cross-level interactions. A complex pattern of results emerged when statistically modelling consummatory anhedonia in terms of positive affective or reward reactivity to events (event anhedonia) or social situations (social anhedonia). Converging evidence in young adults and adults indicated a positive contemporaneous within-person association between positive affect and event pleasantness, positive events, social contact, and psychological or behavioral rewards (or negative association between anhedonia and social contact); these associations generally did not differ by baseline depressive, anhedonia, or schizotypy symptoms ((Heininga et al., 2017; Heininga, Dejonckheere, Houben, & Kuppens, 2019; Heininga, Dejonckheere, Houben, Obbels, et al., 2019; Kwapil et al., 2012; Schricker et al., 2023; Starr & Hershenberg, 2017; van Roekel et al., 2016), for an exception, see (Kwapil et al., 2009)). In young adults and adults with early psychosis, there was similarly limited evidence for blunting of affective experiences (Hermans et al., 2021), with some studies showing larger increases in positive affect when in the company of others, when social satisfaction was high (Collip et al., 2014), and when engaging in pleasant activities (Fung et al., 2023) compared to controls. In adults with psychotic disorders, however, patients reported more event anhedonia compared to relatives and controls, but there were no differences in social anhedonia (Daemen et al., 2022). In adults with schizophrenia, event pleasantness positively correlated with positive affect, but the effect was larger for the remission compared to the non-remission and control groups, for patients with low compared to high negative symptoms, and when with others compared to when alone (Oorschot et al., 2012; Oorschot et al., 2013).

Studies have begun to investigate the within-person relationship between consummatory anhedonia and other elements of context (e.g., structured/unstructured social contexts, light intensity, experiential avoidance), but the results are fragmented, with different contexts being investigated in different samples (Dejonckheere et al., 2021; Fields et al., 2023; Hershenberg et al., 2017; Kasanova et al., 2018; Luther et al., 2023; Te Lindert et al., 2018). For example, various activities, locations, and social contexts influenced consummatory anhedonia at the within-person level in young adults with and without early psychosis (Luther et al., 2023). Other studies provided more insight into associations between anhedonia and other mental health symptoms, including depression, stress, sleep, and suicidal ideation. There was consistent evidence of autocorrelation in positive affect over hours (Heininga et al., 2017; Heininga, Dejonckheere, Houben, Obbels, et al., 2019; Song et al., 2024; van Roekel et al., 2016) and days (Baryshnikov et al., 2023), with only some evidence for increased autocorrelation in samples with current or a history of depressive symptoms (Hawes & Klein, 2024; Song et al., 2024). Regarding stress, in adolescents and young adults, social withdrawal mediated the positive contemporaneous association between stress and anhedonia; further, stress predicted next-day social withdrawal, which in turn predicted next-day anhedonia (Peterson et al., 2021). In a range of samples with psychosis, depression or bipolar symptoms, stress was associated with lower pleasure or higher anhedonia at the same beep (Heininga, Dejonckheere, Houben, & Kuppens, 2019), at the next beep (Gerritsen et al., 2019; Heininga, Dejonckheere, Houben, & Kuppens, 2019), and the next day (Kaiser et al., 2024). In healthy young adults and adults, multiple daily indices of poor sleep were related to blunted consummatory reward responsiveness within the same day (Wieman, Arditte Hall, et al., 2022), but there were mixed results from one day to the next (Bean & Ciesla, 2021; Kalmbach et al., 2017). In adults with depression and suicidal ideation, anhedonia was not a significant predictor of suicidal ideation at the next beep (Ben-Zeev et al., 2012). In a clinical adolescent sample, however, consummatory anhedonia mediated the indirect effect between poor sleep and increased (same-day and next-day) suicidal thoughts (Patel et al., 2024).

Network models showed various contemporaneous and temporal within-person relationships between anhedonia, anxiety, depression, and borderline personality symptoms at the group- and idiographic-level (Ebrahimi et al., 2021; Ebrahimi et al., 2024; Fatimah et al., 2023; Fisher et al., 2017; Fried et al., 2021; Kraft et al., 2022; Marian et al., 2023; Marian & Sava, 2023; Nemesure et al., 2024; Siepe et al., 2024; Starr & Davila, 2012). Anhedonia was connected to symptoms including attention (Kraft et al., 2022), concentration (Marian et al., 2023), lethargy (Ebrahimi et al., 2021; Ebrahimi et al., 2024), and effort (Thonon, Contreras, & Larøi, 2022). Networks also differed between groups (e.g., (van Roekel, Heininga, et al., 2019; Vrijen et al., 2018)). For example, anhedonic young adults had stronger positive pathways from positive emotions to motivation than healthy controls (van Roekel, Heininga, et al., 2019).

3.5.3. Associations between anticipatory and consummatory anhedonia

Twelve studies examined how anticipatory and consummatory anhedonia relate to one another in daily life, building upon existing studies that focused on each component in isolation.

3.5.3.1. Between-person level. One study found that lower average momentary positive affect was associated with lower neural reactivity to reward anticipation at the between-person level in young adults with and without anhedonia (Murray et al., 2022). Three studies computed the difference between momentary anticipatory and consummatory anhedonia to create an index of social affective forecasting. In one study, individuals with schizophrenia were less accurate than controls in forecasting next-day negative but not positive future social interactions, with similar findings for those reporting high trait social anxiety and lower social pleasure (Shovestul et al., 2022). Although this effect was not replicated in another study comparing individuals with schizophrenia and healthy controls (Abel et al., 2024), comparable results were found in depression; all participants, independent of clinical status, overestimated future displeasure but accurately predicted future pleasure (Wu et al., 2017).

3.5.3.2. Within-person level and cross-level interactions. Some studies directly explored contemporaneous and temporal links between anticipatory and consummatory anhedonia at the within-person level in daily life. In healthy adolescents and young adults, reward anticipation prospectively predicted higher positive affect sometime later, which in turn predicted more active behavior (and vice versa) (Bakker et al., 2017). Sub-clinical depression symptoms moderated this relationship, with higher depression linked to a diminished connection between reward anticipation and active behavior over time (Bakker et al., 2017). Increased anticipatory social reward (but not consummatory social reward) was also related to higher positive affect for the rest of the day (Sequeira et al., 2024), and increased anhedonia was linked to lower predicted enjoyment from checking social media and higher suicide risk at the day level (Dreier et al., 2024). Other studies with similar samples found positive associations between engagement in activities, affect, and anticipatory pleasure and motivation over a 3-h interval (Heininga et al., 2023), that anticipatory pleasure predicted higher consummatory pleasure at the next beep in individuals with dysphoria (Li et al., 2019), and that brain activity moderated the lagged association between reward anticipation and activity pleasantness (Bakker et al., 2019). There was also evidence for mood-brightening such that when young adults with higher depressive symptoms did anticipate positive next-day experiences, they contemporaneously reported reductions in depressed mood (Starr & Hershenberg, 2017). Finally, for adults with

schizophrenia, increased consummatory pleasure was contemporaneously associated with increased anticipatory pleasure for leisure and functional activities (Edwards et al., 2018).

3.5.3.3. Response to interventions. Emerging evidence ($n = 13$) indicates that anticipatory and consummatory anhedonia, as well as other related motivational processes, can be improved by psychological interventions, although effects differ within- and between-individuals. Five studies examined healthy adolescent or young adult samples with anhedonia, three of which examined the effects of a personalized lifestyle advice intervention (with or without a tandem skydive component). Lifestyle advice increased positive affect and pleasure, but tandem skydiving had no additional effect (van Roekel et al., 2017). Within-person improvements in positive affect and pleasure were not linked to specific advice types (van Roekel & Oldehinkel, 2023), nor did advice affect the within-person relationship between positive events and increased positive affect (i.e., positive affect reactivity) (Schmitter et al., 2021). Intensive behavioral activation showed mixed results for improving anhedonia (Webb, Murray, Tierney, & Gates, 2022; Webb et al., 2023). Six studies examined interventions in adult samples with depression, anxiety, and/or schizophrenia (Bär et al., 2024; Fisher et al., 2019; Geschwind et al., 2011; Heininga et al., 2023; Thonon et al., 2020; Thonon, Levaux, et al., 2022). Findings were generally positive. For example, a novel blended psychological intervention targeting motivational processes improved pleasure anticipation in adults with schizophrenia and depression (Thonon, Levaux, et al., 2022). Other studies investigated interventions in healthy populations, with no lasting benefits (Bogaert et al., 2023; Parsons et al., 2025).

3.6. What is the quality of reporting in ESM studies assessing anhedonia in daily life (RQ3)?

Table 4 presents the reporting quality across all ESM studies (see Table S9a-b in Supplementary Material D for results of individual studies). Most studies provided a rationale for using ESM ($n = 102$, 90.27 %) as well as some level of information about the technology used to collect data ($n = 110$, 97.35 %), technical details about the sampling scheme ($n = 110$, 97.35 %), full text of ESM items ($n = 111$, 98.23 %), steps for data analysis preparation ($n = 101$, 89.38 %), and data analysis ($n = 113$, 100 %). It is important to note, however, that many of these studies only partially complied with the quality reporting guidelines. A relatively large proportion of studies did not report any information about crucial methodological aspects of their ESM protocol. For example, 39 (34.51 %) of studies did not report procedures to enhance compliance, 47 (41.59 %) studies did not report details about ESM training, 58 (51.33 %) studies did not report design features to address potential sources of bias or burden, and 88 (77.88 %) studies did not report a power analysis to justify sample size. Similarly, most studies did not comply or only partially complied with the reporting quality criteria for the results. Only 20 studies (17.70 %) reported descriptive information about valid ESM data (e.g., number of total observations, mean number of observations per person); 31 (27.43 %) studies reported the number of ESM prompts that were planned to be or were delivered to participants; 6 (5.31 %) studies reported response latency to ESM prompts. Few studies reported pre- or post-registering their hypotheses, research questions, analysis plan, or methods ($n = 13$, 11.50 %) and few studies provided open code ($n = 19$, 16.81 %), open data ($n = 17$, 15.04 %), or an open list of all ESM items ($n = 43$, 38.05 %).

Table 4
Reporting quality assessment results.

Reporting quality criteria	Study compliance N (%)			
	Full	Partial	No	N/A
Title and abstract				
ESM/EMA/AA/IL in title and keywords	33 (29.20)	79 (69.91)	1 (0.88)	
Introduction				
Rationale for using ESM	82 (81.42)	10 (9.73)	11 (9.73)	
Method				
ESM training implemented (and how)	28 (24.78)	38 (33.63)	47 (41.59)	
Procedures to enhance compliance	60 (53.10)	14 (12.39)	39 (34.51)	
Technology specified (hardware/software)	50 (44.25)	60 (53.10)	3 (2.65)	
Sample size justified (power analysis)	18 (15.93)	5 (4.42)	88 (77.88)	2 (1.77)
Rationale for sampling design	7 (6.19)	7 (6.19)	99 (87.61)	
Rationale for sampling density	9 (7.96)	27 (23.89)	77 (68.14)	
Technical details on sampling	36 (31.86)	74 (65.49)	3 (2.65)	
Design features	20 (17.70)	35 (30.97)	58 (51.33)	
Full text of items	62 (54.87)	49 (43.36)	2 (1.77)	
Item reliability and validity	8 (7.08)	58 (51.33)	47 (41.59)	
Valid and missing data defined	51 (45.13)	30 (26.55)	32 (28.32)	
Data analysis preparation	56 (49.56)	45 (39.82)	12 (10.62)	
Data analysis	79 (69.91)	34 (30.09)	0 (0.00)	
Results				
Data description	20 (17.70)	56 (49.56)	37 (32.74)	
Prompt delivery	31 (27.43)	9 (7.96)	73 (64.60)	
Latency	6 (5.31)	54 (47.79)	44 (38.94)	9 (7.96)
Compliance rate	55 (48.67)	21 (18.58)	37 (32.74)	
Missing data	51 (45.13)	8 (7.08)	54 (47.79)	
Limitations	46 (40.71)	31 (27.43)	36 (31.86)	
Transparency and reproducibility				
Pre- or post-registration	13 (11.50)	5 (4.42)	95 (84.07)	
Open materials	43 (38.05)	7 (6.19)	63 (55.75)	
Open code	19 (16.81)	0 (0.00)	94 (83.19)	
Open data	17 (15.04)	3 (2.65)	93 (82.30)	

Note. N/A = not applicable (i.e., criteria are not applicable to studies that used machine learning; latency not relevant to interval contingent daily diary studies).

4. Discussion

The current review is the first to systematically examine the application of ESM to assess anhedonia in daily life in mental health research. We identified 113 original ESM studies, most of which explored anhedonia in depression and psychotic disorders (including psychosis). Anhedonia conceptualization and measurement was heterogenous. There was some evidence that anticipatory and consummatory anhedonia are present across the mental health spectrum, including relatively healthy individuals, and that experiences can vary within-individuals according to context (e.g., activity-type, sleep, stress). Comparison of results across different sub-samples (e.g., adolescents

versus adults, healthy versus clinical) was beyond the scope of this review given the heterogeneity in study design and methodology. The quality of reporting in included studies was generally poor, highlighting the need for transparency and adherence to reporting guidelines in the future (e.g., see (van Roekel, Keijsers, & Chung, 2019)). We discuss these results in more detail below.

4.1. How is anhedonia conceptualized and measured?

Anhedonia was primarily conceptualized in terms of: (American Psychiatric Association, 2022) pleasure, interest, enjoyment, or liking, (Pizzagalli, 2022a) positive affect reactivity, or (Rømer Thomsen et al., 2015) reward-related experiences. Almost half of the studies assessing anhedonia in daily life did not report full ESM item wording, however, making it difficult to determine what exactly was assessed. Constructs measured with similar ESM items were often considered different between studies, while similar constructs were often assessed with a variety of items. These issues are known as the "jingle" and "jangle" fallacies, respectively (Gonzalez et al., 2021). For example, positive affect reactivity was operationalized slightly differently across almost all the 15 studies that assessed it. There was also conceptual similarity between positive affect reactivity, other reward-related indices, and social affective forecasting (see Tables S5-S7 in the Supplementary Materials). For example, two studies examined the contemporaneous relationship between activity pleasantness and positive affect and called it reward experience (Geschwind et al., 2011) or reward reactivity (Heininga, Dejonckheere, Houben, Obbels, et al., 2019). Another measurement problem particularly pronounced in ESM research is lack of psychometric validation (Fritz et al., 2023). In the current review, only three studies developed and initially tested ESM anhedonia items; these items were used in seven other studies (see Table S3 in the Supplementary Materials). Such measurement issues make it difficult to synthesize the findings and interpret whether there is support for a particular component of anhedonia or not.

Anhedonia was conceptualized and measured differently across the mental health spectrum. Anticipatory anhedonia was typically examined in psychotic disorders, whereas consummatory anhedonia was more widespread, examined in all studies on depression and anxiety and most studies on psychotic disorders. Further, studies on psychotic disorders focused on event anhedonia and social anhedonia; studies on depression and anxiety focused on general experiences of pleasure or event anhedonia. These characteristics reflect the conceptualization and typical assessment of psychotic disorders and depression, and the emerging focus of anhedonia in anxiety. For example, anticipatory anhedonia, consummatory anhedonia, and social impairments are considered part of the negative symptom continuum in schizophrenia-spectrum disorders (Krzyzanowski et al., 2022), and reduced ability to feel pleasure (in general) is emphasized in depression (American Psychiatric Association, 2022). A critical finding of our review is that, across the mental health spectrum, patterns of results depended on how anhedonia was measured. We discuss these results below in terms of anticipatory and consummatory anhedonia (including links to behavior).

4.2. What is the experience of anhedonia in daily life?

4.2.1. Anticipatory anhedonia

Theory and research from neuroimaging and behavioral paradigms indicate that depression, more so than schizophrenia, is associated with impairments in anticipatory anhedonia – although there are inconsistencies across in-lab measurements (Craske et al., 2024; Frost & Strauss, 2016; Kieslich et al., 2022; Moran et al., 2022). The current review extends this evidence-base by showing that momentary anticipatory anhedonia is implicated in a range of sub-clinical and clinical samples (depression, schizophrenia, psychosis, sleep, bipolar disorders, anxiety). We also found that context can influence these experiences at the between- and within-person levels. There was evidence at the between-person level that individuals with psychosis and schizophrenia can experience anticipatory pleasure – at least in some contexts – and that this variation might be dependent on motivational processes such as goals and perceived effort (Edwards et al., 2018; Gard et al., 2007; Gard et al., 2014). Further, anticipatory reward responsivity was positively associated with trait valued living and negatively associated with exposure to large scale community stressors (Fields et al., 2022; Wieman, Fields, et al., 2022). At the within-person level, poor sleep and stress were contemporaneously and temporally related to higher anticipatory anhedonia, respectively (Gerritsen et al., 2019; Wieman, Arditte Hall, et al., 2022). There was also emerging evidence that anticipation may be important in activating future motivational processes and behaviors (Pillny et al., 2020; Thonon, Contreras, & Larøi, 2022), and be related to increased engagement in certain daily activities (e.g., studying, working) in early psychosis (Luther et al., 2023). However, most ESM studies explored anticipated pleasure or prospection, that is, the ability to anticipate experiences of pleasure in the future. Other processes, including anticipatory affect, the ability to experience positive emotion-in-the-moment while simulating the future, have not received as much attention (Frost & Strauss, 2016). By capturing temporal and contextual details, ESM can identify experiences that retrospective self-report questionnaires and lab-based paradigms cannot and help to clarify differences across anticipatory processes.

4.2.2. Consummatory anhedonia

Cross-sectional self-report studies generally indicate that consummatory anhedonia is higher in samples with various mental health conditions or symptoms compared to healthy controls, although evidence is somewhat mixed in experimental or lab-based research (Craske et al., 2024; Frost & Strauss, 2016; Kieslich et al., 2022; Krzyzanowski et al., 2022; Moran et al., 2022; Pizzagalli, 2022b; Shankman et al., 2014; Trøstheim et al., 2020). ESM findings from the current review extend this understanding by showing that patterns of consummatory anhedonia were dependent on measurement approach and context. When measured as a single item or computed as a single index, we found evidence for higher average levels of consummatory anhedonia across samples (depression, schizophrenia/psychotic disorders, anhedonic, psychosis, sleep, bipolar disorders, anxiety, borderline personality, schizotypy). When modelled as positive affect reactivity, however, there was evidence that individuals can experience consummatory pleasure across different events and social contexts. This association is evident at the within-person level in healthy samples (Heininga et al., 2017; Kwapil et al., 2012) and in sub-clinical samples (cross-level interactions). For example, those with early psychosis displayed heightened reactivity to pleasant events and social company compared to controls (Collip et al., 2014; Fung et al., 2023), although the nature and intensity of this relationship may vary based on symptom severity (Daemen et al., 2022; Oorschot et al., 2012; Oorschot et al., 2013). Research investigating other contextual factors is fragmented, but there is emerging support for contemporaneous and temporal links between stress and anhedonia (possibly bidirectional) and between sleep and anhedonia (Bean & Ciesla, 2021; Gerritsen et al., 2019; Heininga, Dejonckheere, Houben, & Kuppens, 2019; Kalmbach et al., 2017; Peterson et al., 2021; Wieman, Arditte Hall, et al., 2022). Anhedonia might also have influential relationships with other symptoms such as attention, effort, and motivation, although there is high within-person heterogeneity (Kraft et al., 2022; Thonon, Contreras, & Larøi, 2022; van Roekel, Heininga, et al., 2019).

The current review provides little evidence for a pervasive deficit of consummatory anhedonia across mental health conditions. ESM findings suggest that hedonic experiences are intact in the moment when assessed in relation to context, whereas the experience of pleasure on average throughout the day may be reduced relative to controls (similar to trait-based retrospective findings). Further, ESM research yielded important contextual information by identifying within-person

differences across specific contexts (e.g., social). There was also emerging evidence for how consummatory anhedonia relates to other symptoms at different time-scales. Overall, findings demonstrate the importance of assessing anhedonia in relation to specific contexts or behaviors that are naturally occurring in participants' daily lives (rather than in response to standardized stimuli in lab paradigms) and assessing within-person processes.

4.2.3. Linking anticipatory and consummatory anhedonia

A benefit of ESM is the capacity to link anticipatory and consummatory anhedonia to examine potential reinforcing relationships and how they relate to behavior in daily life. This is an emerging area of research, with few studies examining these links. Emerging results generally support hypotheses put forward from reward-processing models and behavioral activation – anticipation, positive affect, and behavior are positively related over time to create a functioning reward loop in depression (Bakker et al., 2017; Heininga et al., 2023; Li et al., 2019). There is also evidence that anticipatory anhedonia and active behaviors, as well as specific motivation-related processes, are linked in adults with schizophrenia-spectrum disorders (Edwards et al., 2018; Gard et al., 2014; Luther et al., 2023). Future investigation is needed into how anticipatory and consummatory anhedonia are linked in specific contexts (e.g., social, physical, sensory), including temporal relationships between affective forecasting and subsequent behavior. Identifying how and when the components of anhedonia relate to one another will facilitate the development of a temporal and contextual model of anhedonia in daily life.

4.3. What is the quality of reporting?

Most studies did not fully comply with quality reporting guidelines, missing crucial methodological details. Particular areas of concern were providing justifications for the ESM sampling design and density, design features to address potential sources of bias (e.g., asking participants to respond to prompts as soon as possible, or minimizing survey length), item reliability and validity, power analyses, and description of the final ESM dataset (e.g., total number surveys completed). It is critical for future researchers to consider and justify measurement choices, and transparently report all measurement details. Open science practices such as pre-registration of study designs and analytic plans (Kirtley et al., 2021), as well as sharing ESM items through open repositories (e.g., the Experience Sampling Repository; (Kirtley et al., 2024)), are part of the way forward in advancing measurement, and in turn, understanding of anhedonia.

4.4. Clinical implications

Anhedonia was primarily investigated in samples in depression, psychosis, and psychotic disorders; it was less frequently investigated in anxiety, bipolar disorders, borderline personality disorder, or other conditions such as sleep or suicidal ideation. This breakdown likely reflects the widespread recognition that anhedonia is a cardinal symptom of depression and psychotic disorders in traditional nosological classification systems. The focus on anhedonia in depression and psychotic disorders, not only in ESM research but in research more generally, is problematic given the available evidence that anhedonia is experienced in a range of mental health conditions. The overall results from the current review suggest that there is overlap in experiences of anhedonia in daily life across different mental health conditions, converging with existing evidence that it is a transdiagnostic construct (e.g., (Edwards et al., 2019; Guineau et al., 2023; Pizzagalli, 2022a)). One interpretation is that contextual factors, rather than specific mental health symptoms, are more important to consider when examining consummatory and anticipatory anhedonia in daily life. It is important to acknowledge, however, that less than one quarter of the reviewed studies specifically examined anhedonia using a transdiagnostic perspective – that is, by using an anhedonic sample or by comparing experiences of anhedonia among sub-samples with different symptoms (e.g., depression, psychosis, anxiety). Using a transdiagnostic perspective to explore the links between different components of anhedonia is the critical next step to understand how pleasure (or lack thereof) influences behavior and whether there are dissociable patterns irrespective of diagnostic classification. As part of this work, it will be essential to directly compare experiences of anhedonia between samples with different mental health symptoms or diagnoses. This approach will advance the field by expanding beyond the typical focus on anhedonia in depression and psychotic disorders.

Our review found emerging evidence that psychological interventions can be effective in ameliorating anhedonia (or increasing pleasure) in daily life. The interventions, study designs, and samples were vastly different, meaning that replication is needed to further build the evidence-base. However, almost half of the intervention studies were evaluated in transdiagnostic samples consisting of healthy adolescents or young adults with and without anhedonia (assessed at baseline with retrospective questionnaires or clinical interviews). The results indicate that psychological interventions that specifically aim to augment reward processing and positive emotions (Craske et al., 2024) might be helpful to target *anhedonia in daily life*. For example, the personalized lifestyle intervention developed by van Roekel and colleagues (van Roekel et al., 2017) extended typical behavioral activation by using personalization to maximize positive emotional experiences. The lifestyle intervention used participants' own ESM reports to generate tailored advice about what activities they can engage in each day to enhance their pleasure and positive emotion. This approach extends the evidence base because most psychological interventions are designed to improve low mood or negative affect, rather than enhance pleasure or positive affect, and do not evaluate the effects on daily life experiences across hours (e.g., 6-h) (Sandman & Craske, 2022). These types of interventions are promising because they suggest that anhedonia, which is a transdiagnostic risk factor for later mental health problems (Pizzagalli, 2022b), can be targeted in daily life before the potential onset of more severe clinical symptoms.

There was substantial within-person heterogeneity in the effects of the interventions (Thonon et al., 2020; van Roekel et al., 2017; Webb, Murray, Tierney, & Gates, 2022), indicating that personalization is a crucial way forward to maximize benefits for different individuals. Real-time and just-in-time adaptive interventions (Nahum-Shani et al., 2018) are at the forefront of personalized approaches, which tailor and deliver interventions based on within-person fluctuations in contextual factors that increase risk for anhedonia. Although additional research is needed, our review suggests that experiences of pleasure vary across contexts (e.g., social versus non-social, valued versus non-valued, goal-directed versus non-goal-directed, pleasant versus unpleasant) and are likely influenced by cognitions (e.g., effort appraisals, expectancy beliefs). Interventions that target maladaptive beliefs or thinking patterns, and help individuals to access contexts that promote pleasure, may be particularly effective approaches moving forward.

4.5. Methodological implications: ESM item selection

Recommendations for specific ESM items are difficult given the heterogeneity of items used and the way in which they are combined to index different components of anhedonia. Three general recommendations from this review are to: 1) clearly define the anhedonia construct that is intended to be measured with a clear rationale and link to theory (Eronen & Bringmann, 2021); 2) focus on anticipatory and/or consummatory anhedonia (rather than anhedonia in general) to disentangle different reward-processes; and 3) include context, either in the item wording or in the modelling process, to identify when anhedonia is being experienced. Another important consideration is how to capture *difficulties* or *reductions* in pleasure, rather than whether an individual experiences pleasure at one moment or not. One solution is to assess

pleasure over a longer time frame to generate an average or baseline level of experience in daily life and assess relative within-person changes in pleasure; another solution is to assess how much an individual would usually enjoy a particular activity. Note that repeated assessment of negatively formulated questions (i.e., a loss of pleasure) is not recommended in ESM research because it may induce a negative mindset (Eisele et al., 2024; Myin-Germeys & Kuppens, 2022). These recommendations are relevant to anhedonia assessment in general, beyond ESM, and are necessary to advance understanding of anhedonia as a psychological phenomenon (see (De Fruyt et al., 2020; Ho & Sommers, 2013)). Development of a standardized ESM anhedonia library or repository is a crucial next step to aid item selection.

Another consideration is the time-scale of measurement and framing. Most ESM studies investigated anhedonia over a period of hours (e.g., since the last beep) rather than minutes or seconds, and relatively few studies investigated temporal changes. Investigating anhedonia from moment-to-moment over shorter time periods is necessary to identify anhedonic trajectories in daily life, including the immediate influence of context, duration of experiences, and recovery. This nuanced and temporal data is necessary to pinpoint optimal measurement approaches and opportunities for future intervention.

4.6. Limitations and future research

The current review focused on *explicit* measurement of anhedonia in ESM studies, meaning that we focused on studies that defined items as anhedonia or that conceptually linked items to baseline anhedonia throughout the manuscript. A limitation is that studies that use identical or conceptually similar ESM items, but that do not define those items as anhedonia, were not included in the review. Some examples are studies from the affective sciences that focus on positive affect and reward processing, or studies that assessed quality of social experiences and asociality. This approach was necessary to limit the scope of investigation and to enable specific conclusions about how anhedonia has been conceptualized and measured using ESM. Such conclusions are arguably more informative for advancing anhedonia measurement and developing more clinically meaningful insights about anhedonia in daily life. Another limitation stems from the complexity of anhedonia itself. The term anhedonia refers to different experiences in different research traditions and can be deconstructed according to different principles (De Fruyt et al., 2020; Ho & Sommers, 2013; Kieslich et al., 2022; Treadway & Zald, 2013; Winer et al., 2019). We used broad inclusion criteria to capture all ESM studies that measured anhedonia, meaning that we synthesized many "types" of anhedonia that may or may not have been linked to a theoretical background. We do not offer a critical analysis of the types of anhedonia that we identified but suggest that this is a critical part of the decision-making process when selecting or developing new ESM anhedonia items. Finally, approximately 25 % of data extraction and quality assessment ratings were double-coded by independent raters. Given that consistency was high across raters, we are confident that risk of error and/or bias was minimized and that our conclusions are robust.

The findings from this review identify several areas for future research to advance gold-standard measurement and understanding of anhedonia from a transdiagnostic perspective. It is likely that most of the ESM items extracted in the current review can be used transdiagnostically from early adolescence to adulthood (although within-study comparisons of anhedonia across different age groups and mental health conditions are needed). Given that most of these items have not been psychometrically tested or used across a range of mental health conditions, future studies should incorporate tests of validity and reliability where possible into their research designs. This approach will help to overcome limitations of existing trait and state self-report measures of anhedonia, which have been typically developed in either the depression or schizophrenia literatures (Krzyzanowski et al., 2022; Rizvi et al., 2016; Trøstheim et al., 2020), and to build an evidence-base for optimal ESM items. This approach aligns with initiatives that aim to improve ESM measurement in the social sciences (e.g., Measurement is the New Black Consortium, https://mitnb.org/). Finally, to date, few studies have assessed anhedonia using cross-sectional self-reports, lab-based experiments (behavioral, neural), and ESM in combination (for exceptions, see (Bakker et al., 2019; Culbreth et al., 2020; Hooker et al., 2014; Murray et al., 2022; Webb et al., 2023)). The next step is to leverage the strengths of different research designs to integrate measures of anhedonia on different units of analysis (Cuthbert & Insel, 2013). This approach has potential to uncover how ESM measures correspond to lab-based measures, identifying different predictors of experiences, and building a more comprehensive picture of what anhedonia means for different individuals.

5. Conclusion

This review is the first to examine how anhedonia (and its correlates) is studied using ESM in mental health research. Anhedonia is typically defined in terms of pleasure and enjoyment in daily life, although measurement approaches are highly heterogeneous. There is evidence for anticipatory and consummatory anhedonia in a range of mental health conditions, although experiences fluctuate across time and context. There is also emerging evidence for specific daily life correlates of anhedonia (assessed via time-invariant measures at baseline) including affective, cognitive, and behavioral processes. This review demonstrates the importance of using ESM to capture dynamic information about anhedonia experiences that is not captured by traditional retrospective self-report or lab-based measures. Findings underscore the need for transdiagnostic approaches to better understand anhedonia, as well as standardized ESM items and improved reporting for future research.

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CRediT authorship contribution statement

Joanne R. Beames: Conceptualization, Investigation, Writing – original draft, Writing – review & editing, Project administration. **Lotte Uyttebroek:** Investigation, Writing – review & editing. **Clementine J. Edwards:** Investigation, Writing – review & editing. **Gudrun V. Eisele:** Investigation, Writing – review & editing. **Nian D.F. Kemme:** Investigation, Writing – review & editing. **Olivia Collier:** Investigation, Writing – review & editing. **Eeske van Roekel:** Writing – review & editing. **Thomas R. Kwapil:** Writing – review & editing. **Olivia J. Kirtley:** Conceptualization, Writing – review & editing. **Inez Myin-Germeys:** Conceptualization, Writing – original draft, Writing – review & editing, Supervision.

Declaration of competing interest

The authors have no competing interests to declare.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.cpr.2025.102590.

Data availability

No data was used for the research described in the article.

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[2] See Supplementary Material E for a full list of articles included in the review.

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