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Intertemporal Impatience Across Mental Health in a Community Sample: A Novel Transdiagnostic Approach

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ABSTRACT

Intertemporal impatience has been proposed to be centrally and transdiagnostically implicated across mental health difficulties, including maladaptive behaviors, psychopathologies, and other psychological outcomes. We empirically tested this proposal using a novel research approach that integrates *per-category*, *trans-category*, *scale-level*, and *item-level* analyses. First, we studied per-category continuous associations between intertemporal impatience and a broad range of mental health-related behaviors and psychological constructs. Next, we examined which of several latent, trans-category dimensions were associated with impatience, thereby studying which mental health difficulties may be connected through shared impatience. Finally, we investigated which specific symptoms or behaviors were driving these associations. This study was conducted in a community sample of 899 participants who completed an intertemporal choice task and various self-report mental health measures. Per-category analyses involved bivariate correlations and multiple regressions; trans-category analyses involved exploratory factor analyses to identify transdiagnostic dimensions, and structural-after-measurement models to test for associations between the dimensions and intertemporal impatience. Intertemporal impatience was associated with increased nicotine use, reactive aggression, non-planning impulsivity, motor impulsivity, and dispositional greed. Moreover, impatience was positively associated with a transdiagnostic impulsivity dimension (including attention-deficit/hyperactivity disorder, low self-control, and motor and non-planning impulsivity). Symptom-level analyses suggested that this association was mainly driven by information impulsivity (also known as lack of premeditation) and financial impulsivity. Our results provide support for the role of intertemporal impatience across several externalizing but not internalizing mental health difficulties and offer a detailed and nuanced interpretation of the transdiagnostic role of intertemporal impatience across mental health.

Intertemporal impatience, the tendency to forego large future rewards to obtain smaller rewards sooner, has been observed in relation to a wide range of maladaptive behaviors, including poor financial decision-making (Chabris et al. 2008; Meier and Sprenger 2010), unsafe sexual behavior (Johnson et al. 2021), unsafe driving behavior (Daugherty and Brase 2010; Hayashi et al. 2015), and unhealthy food choice (Amlung et al. 2016; Appelhans et al. 2019; Barlow et al. 2016), as well as to individual differences in socioeconomic (e.g., educational attainment and income), personality (e.g., impulsivity), and cognitive (e.g., future orientation) variables (see Keidel et al. 2021 for a review of individual differences research). Moreover, an increasing body of research points toward a central role of intertemporal impatience across maladaptive behaviors and psychological outcomes

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in the domain of mental health, such as substance use and gambling addiction (Amlung et al. 2017; MacKillop et al. 2011), aggression (Koepfler et al. 2012; Moore and Foreman-Peck 2009), attention-deficit/hyperactivity disorder (ADHD; Jackson and Mackillop 2016; Marx et al. 2021; Patros et al. 2016; Pauli-Pott and Becker 2015; Scheres et al. 2024), and depression (Amlung et al. 2019). For instance, an individual struggling with substance abuse may choose the immediate high of a drug over their long-term health.

Following these findings, intertemporal impatience has been proposed as a *transdiagnostic* construct that is shared across mental health difficulties and may pose a risk factor contributing to their development and maintenance (Amlung et al. 2019; Bickel et al. 2012; Lempert et al. 2018).[1] We broadly define mental health difficulties here as maladaptive behaviors (e.g., substance use and aggression), reduced psychological well-being (e.g., low life satisfaction, depression, and anxiety), and individual differences in other psychological constructs (e.g., impulsivity, narcissism, and emotion regulation) that are relevant to mental health, thereby aiming to gain a broad understanding of mental health and its relation to intertemporal impatience. The proposed transdiagnostic role of intertemporal impatience aligns with the Research Domain Criteria (RDoC) framework, which promotes a dimensional approach to mental health and its underlying transdiagnostic processes and emphasizes the importance of studying the role of these processes across the full range of mental health variation, including the nonclinical range (Cuthbert and Insel 2013). In line with this perspective, while we use the term *transdiagnostic* here to be consistent with previous literature and to recognize the relation with the RDoC framework, we extend its use to nonclinical severity levels and to nonclinical mental health difficulties as broadly defined above.

Despite the proposed transdiagnostic role of intertemporal impatience, most studies testing the association between intertemporal impatience and mental health or other psychological outcomes have adopted a *per-category* approach by examining this association for each outcome separately (e.g., Amlung et al. 2019; Levin et al. 2018). Only recently, research has started to adopt *transdiagnostic* research methods, the goal of which is to identify latent transdiagnostic or *trans-category* outcome dimensions and to study how impatience is associated with these dimensions. Using this approach, Levitt et al. (2022) found impatience to be associated with a dimension reflecting depression, anxiety, post-traumatic stress disorder, and ADHD, and with a dimension reflecting substance use. Using a similar approach, Keidel et al. (2024) observed impatience to be associated with an anxiety–depression dimension and with an inattention–impulsivity–overactivity dimension. Finally, Gustavson et al. (2020) observed associations between impatience, a lack of premeditation dimension (reflecting several impulsivity scores), and an internalizing psychopathology dimension (reflecting depression, low subjective well-being, and neuroticism). The scarcity of studies using such methods (also see DeRosa et al. 2024; Oddo et al. 2022; Yeh et al. 2021, for slightly different approaches) warrants replication. Moreover, studies differed in whether they examined the association between intertemporal impatience and *scale-level* (i.e., total questionnaire scores; Levitt et al. 2022) or *item-level* (Keidel et al. 2024) dimensions. While the former reveals scale-level comorbidities and the potential role of intertemporal impatience therein, the latter sheds light on within-category heterogeneity by accounting for the possibility that, for instance, different symptoms within one category are differentially associated with intertemporal impatience. An integration of both approaches promises to provide detailed and complementary insight into the transdiagnostic role of intertemporal impatience. Finally, previous transdiagnostic studies (Gustavson et al. 2020; Keidel et al. 2024; Levitt et al. 2022) used factor score regressions (FSRs) to examine the associations between impatience and extracted transdiagnostic dimension scores, a method that, by ignoring measurement error, can result in inaccurate regression coefficients (Devlieger and Rosseel 2017).

In the current preregistered study, we adopted a novel transdiagnostic research approach that combines *per*-category, *trans*-category, *scale*-level, and *item*-level approaches to study the transdiagnostic role of intertemporal impatience in a predominantly nonclinical community sample. These complementary approaches allowed us to compare results from traditional per-category and recent trans-category research methods, examine unique (i.e., per-category only) and shared (trans-category) associations between impatience and mental health, and gain insight into the mechanisms that underlie scale-level associations by examining which specific symptoms (i.e., items) may be driving these associations. We hereby aimed to provide nuanced and fine-grained insight into the transdiagnostic role of intertemporal impatience. We used structural-after-measurement (SAM) models to examine the associations between impatience and transdiagnostic dimensions, forming a recently developed, unbiased alternative to FSRs that accounts for measurement error (Rosseel and Loh 2024). SAMs also form a more robust and powerful alternative to structural equation models (SEMs; used by Levitt et al. 2022) because they do not require the simultaneous estimation of the measurement and structural model parts (Rosseel and Loh 2024).

Intertemporal impatience was assessed by asking participants to make a series of choices between immediate and delayed monetary rewards (Falk et al. 2016, 2018), which is the most typical method of assessing intertemporal impatience (Lempert et al. 2018). We assessed mental health by asking participants to complete a series of self-report mental health measures, including direct measures of psychological well-being or psychopathology, as well as measures of other mental health-related behaviors and psychological constructs (detailed below).

We first set out to replicate previous work by testing for the per-category, scale-level associations between intertemporal impatience and mental health while adjusting for participant age, sex, education, and income. We expected intertemporal impatience to be positively associated with substance use, gambling, internet gaming disorder, social media disorder, ADHD, depression, autistic traits, perceived stress, aggression, impulsivity, dark triad traits (specifically, psychopathy and narcissism), and maladaptive emotion regulation, and negatively associated with adaptive emotion regulation, self-control, and life satisfaction (see Supporting Information 1, S1, for literature supporting these hypotheses). We did not have directional hypotheses for

the associations between intertemporal impatience and anxiety, dispositional greed, and burnout, following a strong heterogeneity in theories and research findings (for anxiety, see S1), or an absence of existing research showing such associations (for dispositional greed and burnout). Next, we examined the latent structure of the mental health variables to identify trans-category mental health dimensions and tested whether these dimensions were associated with intertemporal impatience. Finally, through item-level analyses, we examined which specific symptoms may have been driving the associations between the scale-level mental health dimensions and intertemporal impatience.

1 | Materials and Methods

This study was preregistered on the Open Science Framework (https://osf.io/kcyr7/). The analysis code is also available on OSF (https://osf.io/fa9rs/).

1.1 | Participants

We included data from 905 adults who participated in the Healthy Brain Study (HBS; Healthy Brain Consortium et al. 2021), a study conducted in a predominantly nonclinical community sample of adults aged 30–39 in the Nijmegen area, the Netherlands. A list of HBS participant exclusion screening criteria can be found in S2. We excluded six participants because their education level was not interpretable and their data could not reasonably be imputed (see S3). Thus, the final sample consisted of 899 participants; see Table 1 for the sample characteristics. A power analysis showed this sample size to provide 95% power to detect small standardized regression coefficients of at least 0.12.

The HBS protocol received ethical approval from the institutional review board of Radboud University Medical Center (reference number 2018-4894) and was carried out in accordance with the provisions of the Declaration of Helsinki. All individual participants provided written informed consent before participating.

1.2 | Procedure

The complete study procedure is described in the HBS protocol (Healthy Brain Consortium et al. 2021). Participants completed three study assessment rounds (A1–A3) over the course of 1 year, each of which included pre-visit online questionnaires; an at-home burst week with several assessments (e.g., physical activity, stress, and sleep tracking using wearable devices); a lab visit with, for example, behavioral, physiological, and neuroimaging assessments; and post-visit online tasks and questionnaires. The intertemporal choice task and mental health questionnaires used for the present study were administered as part of the pre-visit or post-visit online measures. Because not all mental health measures were administered at all three time points, we analyzed data from the first time point at which each measure was administered. For the majority of variables, this was at A1, except for impulsivity (A2) and dispositional greed (A3).[2]

1.3 | Materials

Intertemporal impatience was assessed using the quantitative time-preference measure of the Global Preference Survey (GPS; Falk et al. 2016, 2018). This task consists of a series of five hypothetical monetary choices between an immediate small reward (delivered today) and a delayed larger reward (delivered in a year). The choices were presented using a staircase procedure: Whereas the immediate small reward remained €100 today, the delayed larger reward increased or decreased depending on the participant's responses (see S5). The combination of responses on the five trials resulted in an intertemporal impatience score between 1 and 32.

Table 1 lists the questionnaires used to assess mental health, as well as the secondary study variables sex, age, education, and income. Because we adopted a broad definition of mental health, Table 1 also includes a brief note on how we considered each questionnaire to be related to mental health.[3] A detailed description of all measures, as well as the preprocessing steps for each measure, can be found in S3.

1.4 | Statistical Analyses

All statistical analyses were performed in R (R Core Team 2022). A visualization of the different levels on which the analyses were conducted is provided in Figure 1. The proportion of missing data per variable ranged between 0% and 29% ($M = 15.04\%$). Approximately half of the participants ($n = 481$, 54%) did not have any missing data.[4] The missing data were multiply imputed using the predictive mean matching method (see S6 for details) implemented in the *mice* package (van Buuren and Groothuis-Oudshoorn 2011).

1.4.1 | Per-Category, Scale-Level Analyses

1.4.1.1 | Bivariate Correlations. We computed all bivariate Pearson's r correlations between the mental health variables, intertemporal impatience, and the secondary measures. We also computed Kendall's τ correlations to account for several ordinal, count, and/or strongly positively skewed variables (i.e., the education, income, MATE-Q, IGD, and RPQ-proactive subscales) and for any mild violations of assumptions for the continuous variables.

1.4.1.2 | Regressions. Next, we ran multiple regression analyses to examine the associations between intertemporal impatience (independent variable) and mental health (dependent variable) while adjusting for the covariates age, sex, education, and income. Sex was dummy coded (1 = female, 0 = male). We ran a separate regression model for each mental health (sub)scale. For the regressions that contained the MATE-Q, IGD, or RPQ-proactive aggression subscales as dependent variables, we used a negative binomial or Poisson instead of a Gaussian model family. A sandwich estimator was used to obtain robust covariance matrices, standard errors, test statistics, and p-values.

TABLE 1 | Sample characteristics.

Variable	Scale	Possible range	Observed range	*M* (SD)	*Mdn*	Cronbach's α	Relation to mental health
Sex			60% female, 40% male				
Age		30–39	30–39	33.79 (2.81)	34		
Education		1–6	1–6	4.87 (0.99)	5		
Income		1–13	2–13	8.34 (2.51)	9		
Intertemporal impatience	GPS; Falk et al. (2016, 2018)	1–32	1–32	12.18 (10.68)	8		
Alcohol use	MATE-Q; Schippers and Broekman (2014)	0–6	0–6	2.02 (1.43)	2		Substance (ab)use
Nicotine use	MATE-Q	0–2	0–2	0.18 (0.50)	0		Substance (ab)use
Use of other substances	MATE-Q	0–2	0–2	0.38 (1.19)	0	0.84	Substance (ab)use
Gambling	MATE-Q	0–2	0–2	0.47 (2.18)	0		Addictive behavior
Internet gaming disorder	IGD scale; Lemmens et al. (2015)	0–9	0–8	0.35 (0.92)	0	0.93	Addictive behavior
Social media disorder	SMD scale; Van den Eijnden et al. (2016)	10–40	10–29	12.58 (2.95)	12	0.90	Addictive behavior
ADHD	ASRS-v1.1; Kessler et al. (2005)	0–6	0–6	2.31 (1.53)	2	0.70	In DSM-5
Autistic traits	ATQ; Bralten et al. (2018)	18–72	18–63	35.49 (6.51)	35	0.79	Autism Spectrum Disorder in DSM-5
Depression	QIDS-SR16; Rush et al. (2003)	0–27	0–19	4.63 (3.15)	4	0.78	In DSM-5
Anxiety sensitivity	ASI; Reiss et al. (1986)	0–64	0–42	11.35 (6.92)	10	0.88	High relevance to anxiety
State anxiety	STAI-S; Spielberger (1983)	20–80	20–66	33.48 (8.71)	33	0.95	Temporary measure of anxiety
Perceived stress	PSS-10; Cohen et al. (1983)	0–40	0–33	12.99 (5.86)	13	0.89	High relevance to well-being and DSM-5 disorders

(Continues)

TABLE 1 | (Continued)

Variable	Scale	Possible range	Observed range	*M* (SD)	*Mdn*	Cronbach's α	Relation to mental health
Life satisfaction	SWLS; Diener et al. (1985)	5–35	5–35	26.49 (6.49)	28	0.92	High relevance to well-being
Burnout—exhaustion	UBOS-A; Schaufeli and van Dierendonck (2000)	0–30	0–29	9.74 (5.85)	9	0.88	High relevance to well-being in workers
Burnout—distancing	UBOS-A	0–24	0–24	6.08 (5.31)	5	0.87	High relevance to well-being in workers
Burnout—competence	UBOS-A	0–36	0–36	26.66 (5.62)	28	0.86	High relevance to well-being in workers
Proactive aggression	RPQ; Raine et al. (2006)	0–24	0–13	0.96 (1.54)	0	0.92	Key feature of DSM-5 disorders
Reactive aggression	RPQ	0–22	0–19	4.90 (3.27)	5	0.88	Key feature of DSM-5 disorders
Narcissism	DTDD; Jonason and Webster (2010)	4–36	4–34	15.40 (6.74)	15	0.85	In DSM-5
Psychopathy	DTDD	4–36	4–31	8.48 (4.90)	7	0.84	Key feature of DSM-5 antisocial personality disorder
Machiavellianism	DTDD	4–36	4–32	9.05 (4.99)	8	0.86	Related to DSM-5 antagonism domain
Adaptive emotion regulation	CERQ; Garnefski et al. (2001)	20–100	27–96	64.51 (11.99)	65	0.89	Strong relevance to psychological health and well-being
Maladaptive emotion regulation	CERQ	16–80	16–62	33.61 (8.10)	33	0.86	Strong relevance to psychological health and well-being
Attentional impulsivity	BIS-11; Patton et al. (1995)	8–32	8–28	16.13 (3.31)	16	0.76	Key feature of DSM-5 disorders and its disinhibition domain
Motor impulsivity	BIS-11	11–44	12–32	20.69 (3.56)	21	0.69	Key feature of DSM-5 disorders and its disinhibition domain
Non-planning impulsivity	BIS-11	11–44	11–36	22.82 (17.51)	23	0.73	Key feature of DSM-5 disorders and its disinhibition domain
Dispositional greed	DGS; Seuntjens et al. (2015)	16–80	16–77	38.22 (10.45)	38	0.92	Implicated across several mental health variables[a]

(Continues)

TABLE 1 | (Continued)

Variable	Scale	Possible range	Observed range	*M* (SD)	*Mdn*	Cronbach's α	Relation to mental health
Self-control	SCS; Tangney et al. (2004)	13–65	18–63	40.41 (7.80)	40	0.83	Key feature of DSM-5 disinhibition domain

Note: Measures included in the present study; descriptive statistics of the final sample ($N = 899$) before imputing the data, and from the first time point at which each measure was administered; relation of the outcome variables with mental health. Cronbach's α was computed for all scales consisting of multiple items.
Abbreviations: M = mean, SD = standard deviation, *Mdn* = median, DSM-5 = Diagnostic and Statistical Manual of Mental Disorders.
[a]Seuntjens et al. (2015); Wei et al. 2023; Weller et al. (2025).

1.4.2 | Trans-Category, Scale-Level Analyses

All EFAs and SAMs were performed using the *lavaan* (Rosseel 2012), *lavaan.mi* (Jorgensen 2024), and *mitml* (Grund et al. 2023) R packages.

1.4.2.1 | **EFA.** An exploratory factor analysis was conducted with oblique (promax) rotation to examine how the mental health variables clustered into latent, trans-category mental health dimensions. Diagonally weighted least-squares (DWLS) estimation was used to deal with a mixture of continuous and categorical variables (see S7 for details). We retained factors with eigenvalues of at least 1 (Kaiser 1960) and inspected a scree plot to determine the inflection point (i.e., the point at which the slope starts to level off; Cattell 1966). We aimed for a factor solution that explained at least 50% of the variance in the data (Streiner 1994). In addition to these preregistered extraction criteria, we examined the model fit—with a comparative fit index (CFI) of at least 0.95 and a root mean square error of approximation (RMSEA) below 0.05 as cut-offs—and the proportion of large residuals (with a proportion below 50% and a root mean square residual, RMSR, below 0.05 as cut-offs; Field et al. 2014). After factor extraction, we rotated and cleaned the factor solution, removing indicators with factor loadings < 0.30 and cross-loading indicators in a sequential fashion, based on indicator communalities, factor loadings, and theoretical interpretation.

1.4.2.2 | **SAM.** Next, we performed a structural-after-measurement model (Rosseel and Loh 2024) to examine the relation between the transdiagnostic factors and intertemporal impatience while adjusting for the secondary measures and for the correlations among factors. As briefly described above, previous transdiagnostic research has often used factor score regressions (FSRs), in which latent variables are replaced by factor or sum scores—thereby assuming that they are observed instead of latent—and a linear regression is performed to test for associations with other variables. Crucially, however, the factor or sum scores contain measurement error, resulting in biased regression coefficients and reduced statistical power (Rosseel and Loh 2024). Structural equation models (SEMs), often proposed as alternatives to FSRs, do account for measurement error by incorporating a measurement part (i.e., the latent transdiagnostic dimensions and their indicators) in addition to a structural part (i.e., the associations between the latent dimensions and intertemporal impatience). However, while it is often the structural part that is of primary interest to the researcher (with the measurement part being included simply to account for measurement error), the simultaneous estimation of the measurement and structural parts has two important implications (Rosseel and Loh 2024). First, it makes SEMs highly sensitive to local misspecifications; for instance, a small misspecification in the measurement part (e.g., a mis-specified error variance of a latent variable) will propagate through the entire model, also resulting in biased estimates in the structural part. Second, SEMs require large sample sizes for convergence and unbiased estimation. In response to these constraints, structural-after-measurement models (SAMs) do not simultaneously estimate the structural and measurement parts of the model. Instead, they first estimate the parameters of the measurement part, which are subsequently held fixed to estimate the parameters of the structural part (incorporating

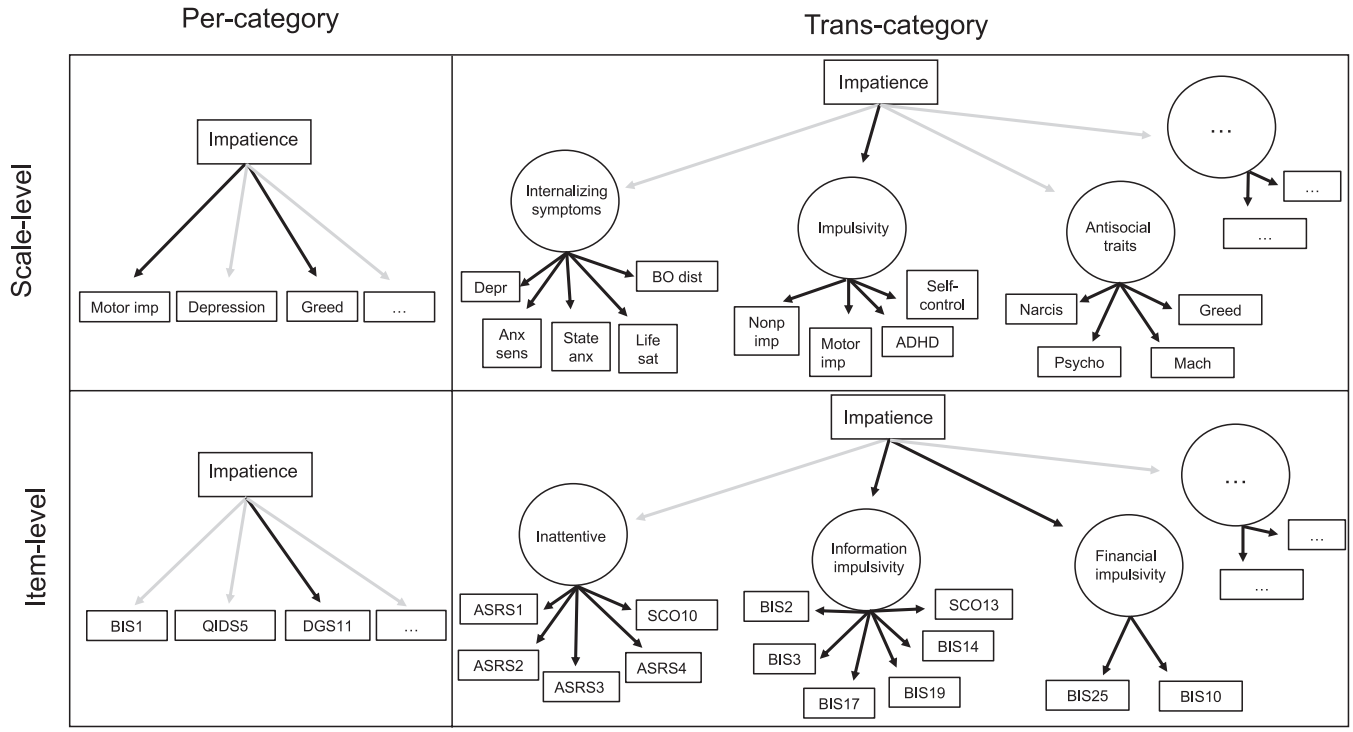

FIGURE 1 | Levels of analyses. *Note:* Visualization of the different levels on which the analyses were conducted. **Top left quadrant:** We first tested for per-category, scale-level associations between intertemporal impatience and the scale-level mental health variables through bivariate correlations and regressions. **Top right quadrant:** Next, we performed an exploratory factor analysis (EFA) to examine how the scale-level mental health variables clustered into latent, trans-category dimensions (i.e., factors). The quadrant displays three out of the seven identified factors, and their indicators, for illustrative purposes. We subsequently performed a structural-after-measurement (SAM) model to test for the associations between intertemporal impatience and the scale-level factors. **Bottom right quadrant:** For the scale-level transdiagnostic factor that was statistically significantly predicted by intertemporal impatience (i.e., impulsivity), we conducted an additional EFA on the items of the mental health scales that loaded on the impulsivity factor, thereby examining the latent symptom-level, trans-category structure of this factor. The quadrant displays three out of the eight identified item-level factors, and their indicators, for illustrative purposes. We subsequently performed an additional SAM to test for the associations between intertemporal impatience and the trans-category, symptom-level factors. **Bottom left quadrant:** To examine the possibility that some mental health items that were not part of any trans-category factors were individually related to intertemporal impatience, we computed bivariate correlations between all individual mental health items and intertemporal impatience. Across all quadrants, secondary measures (e.g., age and sex), variances of latent and observed variables, covariances between all dependent variables, and intercepts of observed variables are omitted from the figure for visual clarity. Foreshadowing some of the results, regression lines displayed in black were statistically significant, while those in gray were nonsignificant—but note that not all (significant and nonsignificant) associations are displayed in the figure (because of space constraints). All arrows indicating factor loadings are displayed in black, regardless of their magnitude.

corrected standard errors to account for uncertainty from estimation in the measurement part). This separation of the measurement and structural parts (often further enhanced by the use of separate measurement blocks for each latent variable) prevents local misspecifications from spreading through the model, making SAMs more robust than SEMs, and requiring smaller sample sizes.

The measurement part of our SAM (Stage 1; estimated using DWLS estimation) contained the latent variable definitions of the factors, with each factor specified in a separate measurement block. The unstandardized factor loading of each first indicator was fixed to 1 to scale the latent variables; if a factor contained only two indicators, the unstandardized factor loadings of both indicators were fixed to 1. The structural part of the model (Stage 2; estimated using maximum likelihood estimation) consisted of as many regression equations as factors, each of which contained one of the factors as the dependent variable, intertemporal impatience as a predictor, and age, sex, education, and income as covariates. The model also estimated the variances of all latent and observed variables, the covariances between all dependent variables, and the intercepts of all observed variables.

1.4.3 | Trans-Category, Item-Level Analyses

1.4.3.1 | EFA and SAM. For the scale-level transdiagnostic dimensions that were associated with intertemporal choice, we conducted an additional EFA and SAM to identify the latent trans-category structure of the *items* within the scale-level dimensions, and to examine which of the resulting symptom-level dimensions were associated with intertemporal impatience. All item scores were treated as ordered variables to account for their categorical nature.

1.4.3.2 | Item-Level Correlations. Finally, to examine the possibility that some mental health items that were not part

of any transdiagnostic mental health dimensions were *individually* related to intertemporal choice, we computed the bivariate correlations between the individual mental health items and intertemporal impatience. We hereby aimed to minimize the chance of overlooking possibly relevant associations between intertemporal impatience and mental health, reducing the Type-II error probability. Acknowledging the increased Type-I error probability resulting from the number of correlations computed, we were careful in interpreting any statistically significant correlations. The results of these analyses are reported in S8.

2 | Results

2.1 | Per-Category, Scale-Level Analyses

2.1.1 | Bivariate Correlations

Figure 2 provides an overview of the bivariate correlations between the study variables. Intertemporal impatience was positively associated with nicotine use (Pearson's $r = .10$, $SE = 0.04$, $p = 0.009$, 95% CI [0.02, 0.17]), reactive aggression ($r = .10$, $SE = 0.10$, $p = 0.005$, 95% CI [0.03, 0.18]), motor impulsivity ($r = .14$, $SE = 0.04$, $p = 0.001$, 95% CI [0.05, 0.22]), and non-planning impulsivity ($r = .15$, $SE = 0.04$, $p = 0.001$, 95% CI [0.06, 0.22]) and negatively associated with autistic traits ($r = -0.07$, $SE = 0.04$, $p = 0.046$, 95% CI [−0.15, −0.001]) and the level of education ($r = -0.14$, $SE = 0.04$, $p < 0.001$, 95% CI [−0.22, −0.06]). Finally, males were significantly more impatient than females ($r = .14$, $SE = 0.04$, $p < 0.001$, 95% CI [0.07, 0.21]). The conclusions from Kendall's τ correlations were consistent, except that the associations with autistic traits and reactive aggression were no longer statistically significant.

2.1.2 | Regressions

When adjusting for the secondary measures age, sex, income, and education, we observed intertemporal impatience to be positively associated with nicotine use ($b = 0.02$, Rate Ratio = 1.02, $SE = 0.01$, $p = 0.038$, 95% CI [0.002, 0.04]), reactive aggression ($b = 0.03$, $\beta = 0.09$, $SE = 0.01$, $p = 0.019$, 95% CI [0.01, 0.05]), dispositional greed ($b = 0.09$, $\beta = .10$, $SE = 0.04$, $p = 0.015$, 95% CI [0.03, 0.16]), motor impulsivity ($b = 0.05$, $\beta = .14$, $SE = 0.01$, $p = 0.002$, 95% CI [0.02, 0.07]), and non-planning impulsivity ($b = 0.04$, $\beta = .10$, $SE = 0.02$, $p = 0.019$, 95% CI [0.01, 0.06]).

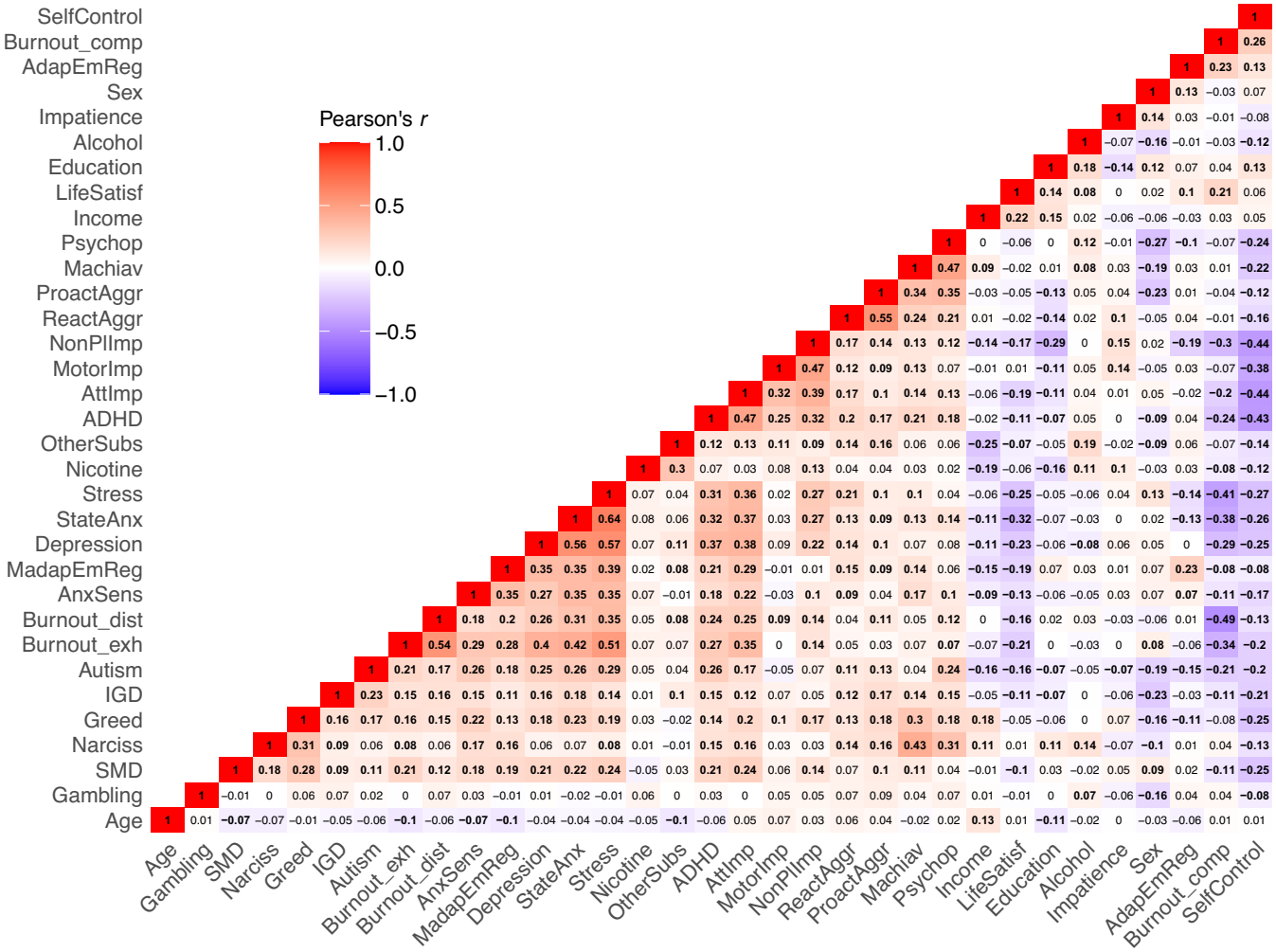

FIGURE 2 | Heatmap Pearson correlations. *Note:* Heatmap of the bivariate Pearson correlations between all study variables. The map was ordered according to the magnitude of the correlation coefficients, thereby portraying clusters of correlated variables. Statistically significant correlations are displayed in bold. IGD = internet gaming disorder, SMD = social media disorder.

2.2 | Trans-Category, Scale-Level Analyses

2.2.1 | EFA

An initial, unrotated EFA on the 28 mental health variables resulted in a seven-factor solution, which contained eigenvalues between 1.01 and 2.47. This factor solution explained 43% of the variance, below our target of 50%. However, a trade-off between the factor eigenvalues and the proportion of explained variance prevented us from obtaining a factor solution that met all preregistered criteria (i.e., an 11-factor solution explained 50% of the variance but included eigenvalues substantially below Kaiser's criterion of 1; see S9 for details). The adopted seven-factor solution maximized the explained variance while being the most parsimonious factor solution that met Kaiser's criterion, was supported by a scree test, showed an excellent fit to the data (RMSEA = 0.03; CFI = 0.96), and had only 11% of residuals larger than 0.05 (RMSR = 0.03). The rotated and cleaned factor solution is presented in S9. We interpreted the factors as mental health dimensions reflecting internalizing symptoms (depression, anxiety sensitivity, state anxiety, stress, mental distancing burnout symptoms, and low life satisfaction), aggression (reactive and proactive aggression), antisocial traits (Machiavellianism, narcissism, psychopathy, and dispositional greed), impulsivity (ADHD, motor impulsivity, non-planning impulsivity, and low self-control), substance use (use of alcohol, nicotine, and other substances), adaptive emotion regulation (adaptive emotion regulation), and autistic traits (autistic traits). Although we refer to the latter two as factors for consistency with the other mental health dimensions, they could also be interpreted as a direct reflection of their observed indicator.

2.2.2 | SAM

A SAM was performed to test for associations between intertemporal impatience and the seven mental health dimensions derived from the EFA. Intertemporal impatience was positively associated with the impulsivity dimension ($b = 0.02$, $\beta = .12$, $SE = 0.008$, $p = 0.006$, 95% CI [0.01, 0.04]) but was not statistically significantly associated with the other six dimensions; see Table 2 for all regression estimates.

2.3 | Trans-Category, Item-Level Analyses

Following the statistically significant scale-level association between intertemporal impatience and the impulsivity dimension, we examined which specific symptoms may be driving this association. Therefore, we performed an EFA on the 41 items of this dimension, followed by a SAM to examine the associations between each of the identified transdiagnostic symptom-level dimensions and intertemporal impatience.

2.3.1 | EFA

The unrotated EFA showed an eight-factor solution to maximize the proportion of explained variance (44%) while retaining only factors with eigenvalues above 1 (ranging between 1.08 and 4.25), showing an excellent fit to the data (RMSEA = 0.04, CFI = 1), and containing only 9% of residuals larger than 0.05 (with an RMSR of 0.03). The rotated and cleaned factor solution is presented in S9. We interpreted the eight factors as symptom dimensions reflecting inattentiveness, information impulsivity, job/residence switching, financial impulsivity, planning, complex-thinking aversion, inhibitory control, and goal-directed motivation.

2.3.2 | SAM

Intertemporal impatience was a statistically significant positive predictor of the symptom dimensions information impulsivity ($b = 0.007$, $\beta = .11$, $SE = 0.003$, $p = 0.012$, 95% CI [0.002, 0.01]) and financial impulsivity ($b = 0.02$, $\beta = .26$, $SE = 0.003$, $p < 0.001$, 95% CI [0.01, 0.02]). All regression results are displayed in Table 3.

3 | Discussion

The present study investigated the association between intertemporal impatience and mental health in a community sample, using a transdiagnostic research approach that combined per-category, trans-category, scale-level, and item-level analyses. Aiming to gain broad insight into the role of intertemporal impatience across mental health, we included a wide variety of measures assessing maladaptive behaviors (e.g., substance use and aggression), reduced psychological well-being (e.g., low life satisfaction and anxiety), and other psychological constructs (e.g., impulsivity and emotion regulation) that are relevant to mental health. Per-category analyses showed that when adjusting for participant sex, age, education, and income, intertemporal impatience was associated with increased levels of nicotine use, reactive aggression, dispositional greed, motor impulsivity, and non-planning impulsivity. The trans-category analyses showed that intertemporal impatience was positively associated with an impulsivity dimension reflecting ADHD, motor impulsivity, non-planning impulsivity, and low self-control. Item-level analyses suggested this association to be mainly driven by a symptom-level dimension reflecting financial impulsivity, that is, the tendency to spend instead of save money, and information impulsivity, that is, the tendency to act without considering the consequences of one's actions. The term information impulsivity was proposed in a recent cross-disciplinary review aiming to integrate different conceptually overlapping concepts and classification schemes in the field of impulsivity research (Fenneman et al. 2022). The authors point toward several terms that have been used across different disciplines to describe the same or strongly overlapping constructs, including a *lack of premeditation* impulsivity component that Gustavson et al. (2020) and Keidel et al. (2024) observed to be associated with increased impatience.

Two general patterns emerged from our results. First, the observed associations between intertemporal impatience and mental health were generally small, with statistically significant standardized regression estimates ranging from 0.09 to 0.15. Although these effect sizes are smaller compared to studies comparing intertemporal impatience between clinical patients and healthy controls (Amlung et al. 2019), they are highly similar to previously reported continuous associations between intertemporal impatience and mental health in general population

TABLE 2 | Regression results scale-level SAM.

		Estimate				
DV	**IV**	***b***	**β**	***SE***	***p***	**95% CI**
Internalizing symptoms	Impatience	0.001	0.006	0.009	0.886	[−0.016, 0.018]
	Age	−0.040	−0.050	0.031	.196	[−0.102, 0.021]
	Sex	**0.360**	**0.077**	**0.167**	**0.031**	**[0.033, 0.687]**
	Education	**−0.183**	**−0.079**	**0.086**	**0.033**	**[−0.351, −0.014]**
	Income	**−0.097**	**−0.107**	**0.034**	**0.005**	**[−0.165, −0.030]**
Aggression	Impatience	0.005	0.055	0.004	.165	[−0.002, 0.012]
	Age	0.016	0.046	0.012	0.212	[−0.009, 0.040]
	Sex	**−0.525**	**−0.270**	**0.071**	**< 0.001**	**[−0.665, −0.385]**
	Education	−0.053	−0.055	0.039	.172	[−0.129, 0.023]
	Income	−0.006	−0.017	0.014	0.654	[−0.034, 0.021]
Antisocial traits	Impatience	0.022	0.063	0.014	.122	[−0.006, 0.050]
	Age	−0.083	−0.062	0.048	0.086	[−0.178, 0.012]
	Sex	**−2.203**	**−0.288**	**0.291**	**< 0.001**	**[−2.777, −1.630]**
	Education	0.218	0.058	0.139	.119	[−0.056, 0.492]
	Income	**0.186**	**.125**	**0.055**	**0.001**	**[0.078, 0.295]**
Impulsivity	**Impatience**	**0.022**	**.123**	**0.008**	**0.006**	**[0.006, 0.037]**
	Age	0.001	0.001	0.024	0.983	[−0.047, 0.048]
	Sex	−0.229	−0.059	0.145	.114	[−0.513, 0.056]
	Education	**−0.427**	**−0.225**	**0.069**	**< 0.001**	**[−0.563, −0.291]**
	Income	−0.045	−0.060	0.027	0.099	[−0.099, 0.008]
Substance use	Impatience	−0.0002	−0.006	0.001	0.894	[−0.003, 0.003]
	Age	**−0.015**	**−0.130**	**0.004**	**0.001**	**[−0.023, −0.006]**
	Sex	**−0.105**	**−0.160**	**0.025**	**< 0.001**	**[−0.155, −0.056]**
	Education	−0.008	−0.025	0.012	0.503	[−0.032, 0.016]
	Income	**−0.043**	**−0.338**	**0.005**	**< 0.001**	**[−0.053, −0.033]**
Autistic traits	Impatience	−0.039	−0.064	0.022	0.082	[−0.083, 0.005]
	Age	−0.118	−0.051	0.083	.156	[−0.282, 0.045]
	Sex	**−2.455**	**−0.185**	**0.480**	**< 0.001**	**[−3.396, −1.513]**
	Education	−0.291	−0.044	0.250	0.245	[−0.783, 0.200]
	Income	**−0.412**	**−0.160**	**0.094**	**< 0.001**	**[−0.595, −0.228]**
Adaptive emotion regulation	Impatience	0.022	0.020	0.043	0.605	[−0.062, 0.107]
	Age	−0.193	−0.045	0.156	0.215	[−0.499, 0.113]
	Sex	**2.850**	**.115**	**0.933**	**0.002**	**[1.018, 4.682]**
	Education	0.706	0.058	0.479	.141	[−0.236, 1.649]
	Income	−0.109	−0.023	0.182	0.550	[−0.465, 0.248]

Note: Regression results from the scale-level SAM model, including unstandardized regression coefficients (*b*), standardized regression coefficients (β), standard errors (*SE*), *p*-values, and 95% confidence intervals (CIs). Significant effects are printed in bold. Significance testing was performed on the unstandardized estimates. For the variable sex, males were coded as 0 and females as 1.

Abbreviations: DV = dependent variable, IV = independent variable.

TABLE 3 | Regression results item-level SAM.

		Estimate				
DV	**IV**	***b***	**β**	***SE***	***p***	**95% CI**
Inattentiveness	Impatience	−0.003	−0.040	0.003	0.328	[−0.008, 0.003]
	Age	−0.009	−0.036	0.009	0.336	[−0.027, 0.009]
	Sex	−0.097	−0.069	0.052	0.062	[−0.198, 0.005]
	Education	−0.029	−0.041	0.026	0.276	[−0.080, 0.023]
	Income	−0.012	−0.042	0.010	0.243	[−0.031, 0.008]
Information impulsivity	**Impatience**	**0.007**	**.110**	**0.003**	**0.012**	**[0.002, 0.013]**
	Age	0.001	0.004	0.010	0.764	[−0.018, 0.021]
	Sex	−0.009	−0.006	0.055	0.875	[−0.117, 0.100]
	Education	**−0.141**	**−0.193**	**0.030**	**< 0.001**	**[−0.200, −0.082]**
	Income	0.013	0.046	0.011	0.237	[−0.009, 0.035]
Job/residence switching	Impatience	0.001	0.016	0.003	0.768	[−0.006, 0.007]
	Age	0.002	0.007	0.011	0.878	[−0.020, 0.023]
	Sex	0.074	0.054	0.063	0.242	[−0.051, 0.199]
	Education	**0.104**	**0.155**	**0.034**	**0.003**	**[0.037, 0.171]**
	Income	−0.012	−0.046	0.012	0.320	[−0.036, 0.012]
Financial impulsivity	**Impatience**	**0.018**	**0.260**	**0.003**	**< 0.001**	**[0.012, 0.024]**
	Age	**0.032**	**.120**	**0.009**	**0.001**	**[0.013, 0.050]**
	Sex	**0.129**	**0.085**	**0.064**	**0.047**	**[0.002, 0.256]**
	Education	**−0.200**	**−0.267**	**0.029**	**< 0.001**	**[−0.256, −0.143]**
	Income	**−0.033**	**−0.111**	**0.012**	**0.009**	**[−0.057, −0.008]**
Planning	Impatience	0.001	0.026	0.002	0.544	[−0.003, 0.006]
	Age	0.003	0.016	0.008	0.696	[−0.013, 0.019]
	Sex	**−0.143**	**−0.128**	**0.043**	**0.001**	**[−0.228, −0.058]**
	Education	**−0.110**	**−0.197**	**0.022**	**< 0.001**	**[−0.154, −0.065]**
	Income	**−0.022**	**−0.100**	**0.010**	**0.023**	**[−0.041, −0.003]**
Complex thinking aversion	Impatience	0.004	0.045	0.003	0.306	[−0.003, 0.010]
	Age	−0.005	−0.016	0.011	0.670	[−0.027, 0.018]
	Sex	**0.288**	**.170**	**0.069**	**< 0.001**	**[0.151, 0.424]**
	Education	**−0.247**	**−0.294**	**0.035**	**< 0.001**	**[−0.315, −0.178]**
	Income	−0.002	−0.005	0.014	0.914	[−0.029, 0.026]
Inhibitory control	Impatience	−0.002	−0.053	0.002	0.219	[−0.005, 0.001]
	Age	**0.013**	**0.089**	**0.006**	**0.027**	**[0.001, 0.025]**
	Sex	**0.178**	**0.213**	**0.033**	**< 0.001**	**[0.114, 0.242]**
	Education	−0.022	−0.053	0.015	.163	[−0.052, 0.009]
	Income	0.004	0.027	0.006	0.461	[−0.007, 0.016]

(Continues)

TABLE 3 | (Continued)

DV	IV	Estimate				
		b	β	*SE*	*p*	95% CI
Goal-directed motivation	Impatience	−0.002	−0.061	0.001	.144	[−0.004, 0.001]
	Age	−0.002	−0.016	0.004	0.671	[−0.010, 0.006]
	Sex	−0.030	−0.048	0.023	.194	[−0.076, 0.015]
	Education	**0.039**	**.123**	**0.011**	**0.001**	**[0.016, 0.061]**
	Income	−0.0002	−0.002	0.004	0.965	[−0.009, 0.009]

Note: Regression results from the item-level SAM model, including unstandardized regression coefficients (*b*), standardized regression coefficients (β), standard errors (*SE*), *p*-values, and 95% confidence intervals (CIs). Significant effects are printed in bold. Significance testing was performed on the unstandardized estimates. For the variable sex, males were coded as 0 and females as 1.

Abbreviations: DV = dependent variable, IV = independent variable.

samples (Keidel et al. 2024; Levin et al. 2018; Levitt et al. 2022). They are also consistent with reported associations between intertemporal impatience and individual differences in personality and cognitive variables (Daugherty and Brase 2010; Funder and Ozer 2019; Yeh et al. 2021), as well as more generally with research suggesting small-sized associations in large-scale individual differences studies in psychology to be expected and realistic (Bartoš et al. 2023; Eisenberg et al. 2019; Funder and Ozer 2019; Gandhi et al. 2024; Owens et al. 2021; Weinerová et al. 2022). Moreover, we consider the observation that behavior on a simple intertemporal choice task predicts various forms of self-reported mental health (while adjusting for several secondary measures) to be of non-trivial relevance, also when effect sizes are small (as also argued by Eisenberg et al. 2019; Funder and Ozer 2019).

Second, while we observed several statistically significant associations between intertemporal impatience and mental health difficulties that have previously been classified as externalizing (e.g., nicotine use, reactive aggression, and impulsivity), we did not observe statistically significant associations with mental health difficulties classified as internalizing (e.g., depression, anxiety, and stress).

The relevance of impatience for several mental health difficulties previously classified as externalizing is consistent with a previously reported association between intertemporal impatience and a latent externalizing psychopathology factor (Finn et al. 2015). Among the externalizing mental health symptoms assessed in the present study, and across the different types of analyses conducted, impulsivity showed the strongest and most consistent association with intertemporal impatience. This supports conceptual and empirical associations between intertemporal impatience and impulsivity (Baumann and Odum 2012; Gustavson et al. 2020; Jauregi et al. 2018; Keidel et al. 2021, 2024; Malesza and Kalinowski 2021; Malesza and Ostaszewski 2016; Zhou et al. 2021).[5] The role of financial impulsivity and information impulsivity as the most relevant symptom dimensions is also in line with previous studies showing intertemporal impatience to be predictive of poor financial decisions (Chabris et al. 2008; Meier and Sprenger 2010) and with studies showing robust associations between impatience and a *lack of premeditation* impulsivity component, as discussed above (Gustavson et al. 2020; Keidel et al. 2024). We acknowledge that the particularly strong association between intertemporal impatience and financial impulsivity may have been bolstered by the fact that both constructs revolve around monetary outcomes, in line with a domain-specific role of impatience (Lawyer and Schoepflin 2013; Rasmussen et al. 2024). At the same time, research has generally found intertemporal impatience across different domains (monetary and non-monetary) to be correlated (Odum 2011; Odum et al. 2020), suggesting impatience to have trait-like characteristics that generalize across domains. Moreover, while we are not aware of research using non-monetary intertemporal impatience to predict financial behaviors, monetary intertemporal impatience has been associated with a wide range of non-monetary (e.g., sexual, food, substance use, or environmental) behaviors (e.g., Amlung et al. 2017; Appelhans et al. 2019; Barlow et al. 2016; Cheung et al. 2022; Hardisty and Weber 2009; Johnson et al. 2021; MacKillop et al. 2011; Reimers et al. 2009), in line with a cross-domain predictive role of intertemporal impatience. The association between monetary impatience and information impulsivity as reported in the present study further supports a predictive role that extends beyond domain-specific effects. Therefore, we would expect the statistically significant association between intertemporal impatience and financial impulsivity to hold even when a non-monetary intertemporal choice task is used (as both tap into a domain-general process), although the size of this cross-domain association may be somewhat weaker. We encourage future research to test this prediction.

Our combined per-category, trans-category, scale-level, and item-level approach offers fine-grained insight into the associations between intertemporal impatience and mental health observed here. Importantly, it also provides some nuance to the proposed widespread transdiagnostic role of intertemporal impatience. First, despite being part of the latent impulsivity dimension, ADHD did not show any per-category scale-level or item-level associations with intertemporal impatience. A similar discrepancy between per-category and trans-category ADHD–impatience associations was observed by Keidel et al. (2024). This discrepancy could suggest that a shared increased intertemporal impatience is *not* the main driving force for the connection between ADHD and the remaining indicators of the latent impulsivity dimension. Our trans-category, item-level results point

toward inattentiveness or a hyperactivity-induced goal-directed motivation as possible alternative processes underlying the connection between ADHD and the remaining impulsivity indicators. Alternatively, the per-category association between ADHD and intertemporal impatience may be stronger for intertemporal choice tasks that require participants to wait for the delayed rewards, consistent with a delay aversion as possible mechanism of impatience in ADHD (Sonuga-Barke et al. 1992) and in line with results by Scheres et al. (2008).

Second, although the impulsivity dimension was the only scale-level transdiagnostic dimension associated with intertemporal choice, some indicators of the other dimensions showed unique per-category associations with intertemporal impatience. For instance, although the substance-use dimension was not associated with intertemporal impatience, nicotine use did show a positive association. The association between intertemporal impatience and nicotine use aligns with a large body of literature (Amlung et al. 2017; Bickel et al. 2012; Levitt et al. 2022; MacKillop et al. 2011) and shows that this association holds in a nonclinical range. Moreover, the statistically significant association with nicotine but not with alcohol use is consistent with the findings by Levitt et al. (2022), although they also found significant (yet weaker) associations with the use of other substances. Within the aggression dimension, only reactive aggression was associated with intertemporal impatience. This aligns with reactive aggression as a response to an immediate threat or emotion, versus proactive aggression as more premeditated (Miller and Lynam 2003; Moore and Foreman-Peck 2009). Finally, among the antisocial traits dimension, only dispositional greed was associated with intertemporal impatience. Our results thus suggest that any connection or comorbidity between nicotine use, reactive aggression, and dispositional greed seems to be weaker than each variable's connection with the other indicators in their transdiagnostic mental health dimensions, again providing nuance to the proposed transdiagnostic role of intertemporal impatience as driving between-disorder comorbidity.

Unexpectedly, none of the internalizing mental health variables were associated with intertemporal impatience, neither on a per-category nor trans-category level. While this concurs with previous null findings on the association between intertemporal impatience and anxiety (Jenks and Lawyer 2015; Levin et al. 2018; Steinglass et al. 2017; Worthy et al. 2014), it contrasts with previous research on other internalizing mental health variables (e.g., depression, stress, and low life satisfaction; Agrawal et al. 2023; Amlung et al. 2019; Gustavson et al. 2020; Keidel et al. 2024; Kennedy 2020; Lempert et al. 2012; Levitt et al. 2022; Malesza 2019). Although many of the studies on impatience and internalizing psychopathologies (e.g., depression) adopted a categorical approach (i.e., comparing patients versus controls, or individuals above versus below a cut-off),[6] statistically significant continuous associations have also been reported by studies adopting a dimensional approach (Gustavson et al. 2020; Keidel et al. 2024; Levin et al. 2018; Levitt et al. 2022). The magnitude of previously reported continuous associations was, however, larger than those reported here (e.g., absolute correlations between impatience and depression ranged between 0.11 and 0.16). Thus, it is possible that associations do exist but were too small to be detected in the present study. We conclude that our results do not provide evidence for the role of intertemporal impatience as a transdiagnostic construct across internalizing mental health difficulties.

3.1 | Strengths and Limitations

The present study carries several strengths. That is, our study was preregistered and had 95% power to detect small standardized regression coefficients of at least 0.12, in line with previously reported associations between impatience and mental health. Moreover, our transdiagnostic approach offers fine-grained and nuanced insight into the role of intertemporal impatience across mental health while revealing and accounting for comorbidity, heterogeneity, measurement error, associations between transdiagnostic dimensions, and several covariates. The broad range of mental health variables included allowed us to examine the predictive value of intertemporal impatience across clinical and nonclinical variables, extending the relevance of our findings also to the field of decision-making, personality, and individual differences more generally.

Our study also carries limitations. First, while we extracted a latent internalizing mental health dimension, we did not extract a latent dimension encompassing all externalizing mental health difficulties. Therefore, we did not directly test for and thus cannot draw strong conclusions about differential associations between intertemporal impatience and internalizing versus externalizing difficulties. Future research could adopt a confirmatory approach to investigate whether impatience is indeed more relevant for externalizing than internalizing transdiagnostic dimensions. In order to obtain a factor solution with distinct internalizing and externalizing dimensions that explains sufficient variance, however, a narrower selection of mental health questionnaires that directly tap into both dimensions may be required. That is, while the broad range of mental health variables adopted in the current study provides us with broad insights into the role of intertemporal impatience across mental health, it may have reduced the amount of shared (versus unique) variance across variables, capturing more divergent mental health domains than could be explained by a small number of factors. An alternative explanation for the relatively low common variance, and forming a second limitation of the present study, is that the use of a predominantly nonclinical sample restricted the range of mental health symptoms (reflected by the positive skew in mental health scores, i.e., many participants reporting few mental health difficulties). We recommend that future studies sample more participants at the higher end of the severity spectrum. In addition to possibly increasing common variance across mental health variables, this would allow one to study whether the role of intertemporal impatience across mental health, especially for internalizing symptoms, becomes more prominent at more severe levels of mental health symptoms, pointing toward possible nonlinear associations (as also suggested by Cuthbert and Insel 2013). Consistent with this idea, Lempert et al. (2025) observed anxiety and depression symptoms to be associated with increased intertemporal impatience in individuals with obsessive-compulsive disorder but not in healthy controls, arguing that a linear relationship between anxiety or depression and intertemporal impatience emerges only when a certain

threshold is reached. Similarly, although with smaller sample sizes, Olson et al. (2024) observed anhedonia symptoms to be associated with increased impatience in individuals with post-traumatic stress disorder but not in healthy controls, and Steinglass et al. (2017) observed anxiety symptoms to be associated with decreased intertemporal impatience in individuals with obsessive-compulsive disorder but not in healthy controls. None of these studies, however, explicitly tested for nonlinear continuous associations; we encourage future research to test for such associations in large samples with high variability in internalizing mental health symptoms. Third, by focusing on cross-sectional associations between intertemporal impatience and mental health, we could not draw conclusions about their causal direction. Examining the direction of these associations forms a highly relevant avenue for future research. Fourth, our study did not include mental health categories that have previously been associated with *decreased* intertemporal impatience, such as anorexia nervosa (see Amlung et al. 2019, for meta-analytic findings). In line with intertemporal impatience and mental health as dimensional constructs, we encourage future research to examine whether or not the proposed transdiagnostic role of intertemporal impatience holds on this end of the impatience spectrum. Fifth and finally, our study only used one choice-based measure of intertemporal impatience, asking individuals to make binary choices between sooner smaller and later larger rewards. While this type of task is extremely common in the field of intertemporal choice, has been shown to result in more consistent responding compared to several non-choice intertemporal choice tasks (Attema and Brouwer 2013; Lipman and Attema 2024), and previous research using such choice tasks have shown ample associations with mental health, it would be interesting to examine whether similar or different results are observed when alternative types of tasks (e.g., bidding or matching tasks, or questionnaires assessing daily-life impatience), or alternative scoring methods within the same task (e.g., indifference points, area under the curve, or discount rates) are used. As an illustration, de Water et al. (2024) compared associations between intertemporal impatience and ADHD using different scoring methods, showing comparable associations for some but not all methods. It would be relevant to extend such approach beyond ADHD, possibly in a transdiagnostic manner.

3.2 | Conclusions

In conclusion, the results from the present study suggest that intertemporal impatience plays a role across several externalizing mental health difficulties, especially those characterized by impulsivity. At the same time, some mental health variables showed unique associations with increased intertemporal impatience without clustering together in a latent mental health dimension, and not all variables within the impulsivity dimensions were individually associated with intertemporal impatience. This nuanced image of the role of intertemporal impatience across mental health emphasizes the value of using complementary per-category, trans-category, scale-level, and item-level analyses. We did not find evidence for a transdiagnostic role of intertemporal impatience across internalizing mental health difficulties. We recommend future research to examine whether this role may be restricted to more severe internalizing symptoms.

Author Contributions

F.B., K.R., A.S., and B.F. conceptualized this study. F.B. analyzed the data, with support from W.J.B. and T.D.J. The manuscript was drafted by F.B. All authors edited the manuscript and approved the final version of the manuscript for submission.

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Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

The data that support the findings of this study are not publicly available because of privacy or ethical restrictions. However, any researcher or reviewer can be granted access for replication studies or checks of scientific integrity. Such requests should be directed to the Healthy Brain Consortium.

Endnotes

[1] Most research on the associations between intertemporal impatience and mental health is cross-sectional, thus precluding us from drawing conclusions regarding their causal direction. Nevertheless, prospective studies suggest intertemporal impatience to play an etiological role in the development and persistence of mental health difficulties, with the strongest evidence for substance use disorders (Amlung et al. 2017).

[2] To facilitate future research on longitudinal associations between intertemporal impatience and mental health in this sample, we reran our trans-category analyses while only including measures that were administered at all three time points. The results are discussed in S4.

[3] For some questionnaires that were somewhat more distantly related to mental health (e.g., dispositional greed), our decision to include this measure was strengthened by the construct's conceptual relation with impatience, encouraging us to explore the empirical association.

[4] Among the participants with missing data, the most common missingness patterns included (i) missing all post-visit but not pre-visit measures (15%), (ii) missing only the impulsivity and dispositional greed scales (13%; these were the only measures for which the first assessment took place at A2 or A3, and they therefore suffered from more missing data because of general study attrition), (iii) missing the impulsivity scale only (7%), and (iv) missing the dispositional greed scale only (6%). The HBS team became aware of the high missingness among post-visit measures while running the study and increased the number of reminders sent to participants, which successfully reduced the missingness as new participants were enrolled in this study. However, because we wanted to use all data (not just from new participants), the data still contained a relatively high overall proportion of missingness. Missingness occurred almost exclusively at the scale level, with only rare instances of item-level missingness. By imputing data at the item level (see S6 for details), our imputation strategy covered both item-level and scale-level missingness.

[5] Also see, for example, Lane et al. (2003), McCarthy et al. (2016), McLeish and Oxoby (2007), Reynolds et al. (2006), and Yeh et al. (2021),

however, for studies reporting no associations between intertemporal impatience and impulsivity.

[6] As described in detail in S10, intertemporal impatience was significantly positively associated with depression when taking a more categorical instead of dimensional approach. The effect size remained near-identical, however, suggesting that our analytic approach did not strongly influence effect sizes.

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Supporting Information

Additional supporting information can be found online in the Supporting Information section. **Data S1:** Supporting Information.