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Title: **Predicting Negative Symptoms: A Novel Scale for Assessing Anticipatory Cognitive Mechanisms in Psychosis**

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Predicting Negative Symptoms: A Novel Scale for Assessing Anticipatory Cognitive Mechanisms in Psychosis

Abstract

Negative symptoms are a central feature of the schizophrenia spectrum and also appear subclinically in healthy individuals, being associated with poor functional outcomes. Although clinician-rated measures remain the gold standard, self-report tools offer efficiency and a direct insight into subjective experiences. **Objective**: This study presents the development and validation of the Negative Symptoms Anticipation Scale (NSAS), a novel self-report instrument designed to assess anticipatory cognitions related to negative symptoms. **Method**: In a pilot study, an initial 28-item version was refined to a final 16-item version organized into three factors: (1) Anticipation of Social Difficulties, (2) Anticipation of Relationship Difficulties, and (3) Anticipation of Low Energy in Daily Activities. **Results**: In a community sample (N = 3,237), the NSAS demonstrated excellent internal consistency (α = .927, ω = .926; α ordinal = .949) and test–retest reliability, as well as a robust factor structure confirmed via confirmatory exploratory analysis ($CFI \geq .997$; $RMSEA \leq .025$). Factorial invariance was established across gender and age, and ROC curve analysis indicated outstanding predictive ability for identifying individuals at risk for transitioning to psychosis (AUC = .905). Convergent validity was supported by moderate to high correlations with established measures of negative symptoms and negative schizotypy. Hierarchical linear regression showed that, when controlling for social anhedonia and depression, the anticipatory component contributed approximately 7–25% of the variance in negative symptoms. **Conclusions**: These findings support the validity of the NSAS and suggest that its application could facilitate early detection and intervention in psychosis.

Keywords: anticipation, negative symptoms, predictive processing, psychotic symptomatology, instrument development, non-clinical sample

Public Significance Statements

The new scale developed in this study measures how individuals anticipate future difficulties in motivation and social life—cognitive patterns linked to early psychosis. These anticipations may help predict who is at risk, making the tool valuable for screening and preventing more severe mental health problems.

Introduction

Negative symptoms (NS) — classified into anhedonia, avolition, blunted affect, social withdrawal, and alogia (1)—are highly prevalent in schizophrenia and related psychotic disorders (2) and have a significant impact due to their resistance to treatment and strong association with low remission rates (3). They are typically among the first symptoms to emerge and markedly reduce patients' functional capacity in daily life (4–6). Over recent decades, considerable attention has been paid to the conceptualization of negative symptoms (7,8).

Assessment of negative symptoms has been primarily based on observer-rated scales, which require clinical interviews and can be influenced by the evaluator's experience (9,10). The European Psychiatric Association (EPA) recommends combining hetero-evaluation tools (e.g., the Brief Negative Symptom Scale – BNSS, and the Clinical Assessment Interview for Negative Symptoms – CAINS) with self-report measures, such as the Self-evaluation of Negative Symptoms (SNS) (11). Self-report evaluations not only complement hetero-assessments but also provide a measure of the subjects' internal experience of negative symptoms (11). By placing patients at the center of their care, these tools can enhance awareness and comprehension of symptoms, promote greater treatment engagement, empower patients (11,12), and potentially improve communication with clinicians. In addition, self-report is efficient and appears particularly suitable for detecting symptoms in the early stages (13).

Despite these advances, assessment remains challenging in both research and clinical practice (11). Given the complexity and multifactorial nature of NS, an effective assessment tool must consider the interaction among multiple dimensions to guide clinical decision-making and, ideally, prevent their onset.

One important dimension is the *anticipation of negative symptoms*, which we define as the cognitive tendency to expect future difficulties in domains commonly affected by negative symptoms: social interactions, romantic/affective relationships, and everyday activities. Critically, this construct is conceptually distinct from the negative symptoms themselves (e.g., anhedonia or amotivation) and from broader dysfunctional beliefs (e.g., defeatist performance beliefs), although these phenomena are interrelated. The Negative Symptoms Anticipation Scale (NSAS) is a self-report measure specifically developed to assess these anticipatory cognitions, capturing the extent to which individuals expect future experiences of low motivation, reduced energy, social disengagement, or relational difficulties. In other words, the NSAS measures the cognitive expectations that may precede or contribute to the development of negative symptoms, rather than measuring the symptoms themselves. This framework allows items to reflect different expressions—such as anticipated lack of ability, reduced effort/energy, or emotional indifference—while maintaining coherence under the central construct of anticipatory negative symptom cognition.

Based on cognitive theories of negative symptoms (14,15), particularly Beck's model, anticipatory processes—such as expectations of fatigue, low effort, or social failure (16–19) — play a central role in the development and maintenance of motivational deficits. According to this model, dysfunctional beliefs about oneself, others, and the future generate rules such as "if I try, I will fail," which reduce goal-directed behavior and promote social withdrawal. These anticipatory cognitions are thought to influence both the likelihood of engaging in goal-directed activity and the anticipation of pleasure or reward, thereby contributing to the expression of negative symptoms such as avolition, social withdrawal, and reduced activity. The *Negative Symptoms Anticipation Scale* (NSAS) was developed to operationalize these anticipatory

cognitions, capturing expectations across social, relational, and daily-life domains. By targeting these processes, the NSAS provides a framework for understanding how cognitive expectations drive motivational impairments and may precede or maintain negative symptoms, complementing existing scales that assess the symptoms themselves or broader dysfunctional beliefs.

Empirical evidence supports the importance of anticipatory processes in schizophrenia. For instance, it has been consistently shown that, in patients with negative symptoms, there is an alteration in anticipatory pleasure while consummatory experience remains relatively intact (20,21). Other studies have indicated that difficulties in anticipating positive experiences are related to negative symptoms (20–22). In particular, Engel et al. (23) found that patients with schizophrenia anticipate negative emotions more intensely than controls, suggesting a negative bias in forecasting social experiences. These findings support the hypothesis that deficits in anticipation are not solely due to neurocognitive problems —such as impairments in working memory, executive functioning, and prospective imagination, which are required to mentally represent future rewards (22,24,25)—but also to dysfunctional beliefs that reduce social engagement. Traditionally, anticipatory pleasure deficits in schizophrenia have been linked to neurocognitive alterations—since anticipating pleasure involves imagination and memory (24,25). However, the cognitive model of negative symptoms suggests that dysfunctional beliefs, such as expecting little pleasure or social rejection, are more influential in driving withdrawal and lack of engagement (18,26).

Research has predominantly focused on dysfunction in reward anticipation without delving into how anticipatory expectations may affect other negative symptoms such as apathy,

asociality, or low energy and motivation. For example, while Engel et al. (23) have evidenced a bias toward the anticipation of negative emotions in social contexts, the extent to which anticipating difficulties (e.g., expecting to feel apathetic or socially disconnected) directly contributes to the manifestation of these symptoms remains to be systematically explored.

In this context, the development of the NSAS is especially relevant, as it seeks to fill this gap by broadly assessing anticipatory cognitions related not only to pleasure but also to other critical domains (such as social difficulties and low energy). This approach not only broadens our understanding of the mechanisms underlying negative symptoms but also paves the way for targeted therapeutic interventions.

Although research on NS has largely focused on schizophrenia, multiple studies indicate that these symptoms also appear subclinically in the general population (27–29), being associated with significant distress (27) and an increased risk of psychiatric disorders (29). In fact, negative symptoms are observed in approximately 20% of young (ages 25 to 34) and adolescent populations, at least in an attenuated form (29,30), and in disorders other than schizophrenia (31). In Europe, for example, 13.8% of young adults (16–40 years) exhibit psychotic symptoms, including ultra-high risk for psychosis (32). Studying subclinical negative symptoms in healthy individuals is relevant as they have been used as criteria in high-risk research and show continuity in both the general population and in associated anhedonia (33–37). Indeed, social anhedonia has been shown to be continuously distributed in the population—even among individuals without a clinical diagnosis (31,38,39) —which supports the notion that other negative symptoms may follow a similar continuum (33,36). This perspective underscores the

importance of assessing anticipatory cognitions related to negative symptoms not only in clinical but also in nonclinical samples.

Consequently, the present study aims to address this gap by introducing the Negative Symptoms Anticipation Scale (NSAS), a new self-report measure designed to assess the expectations and anticipatory processes related to negative symptoms. In addition to evaluating its factor structure, reliability, and validity in a large community sample, we examined its predictive capacity by determining the cutoff point for identifying individuals at risk for psychosis. Furthermore, hierarchical linear regression was conducted to investigate whether the anticipatory component contributed uniquely to the variance of negative symptoms. Integrating these analyses not only helps validate the new scale but also provides key insights into cognitive mechanisms that may be susceptible to intervention in psychosis.

Method

Participants

The study sample consisted of a total of 3,237 participants recruited from four annual cohorts between 2022 and 2025. Participants' ages ranged from 15 to 90 years (M = 30.74; SD = 14.77), with 65.5% identifying as female. Additional sociodemographic characteristics can be found in Table 1.

Recruitment was conducted using non-probabilistic convenience sampling and a snowball procedure. Voluntary participation was offered to psychology undergraduates from the universities of Seville and Cádiz (Spain), who in turn invited three individuals from their close networks (friends, partners, and/or family). As an incentive, participating students received an

academic bonus equivalent to 0.5 points. Those who did not participate had the option of obtaining an equivalent bonus by completing a bibliographic reference search task.

Inclusion criteria required participants to be at least 15 years old, to ensure comprehension of the items, and to be Spanish speakers. For participants aged 15–17 years, informed parental/guardian consent was obtained electronically prior to participant assent, with the online procedure recording both parental consent and the minor's assent. Participants who failed sincerity checks or did not complete all measures were excluded. In line with the recommendations of Moritz et al. (40) for online assessments, 137 responses were eliminated due to bias on the Moritz control scale or scoring below five on a sincerity scale (41). In addition, between 2020 and 2021 a pilot study was conducted with an initial sample of 1,039 participants, which was reduced to 975 after data cleaning.

The study was approved by the Clinical Research Ethics Committee of the Junta de Andalucía (Spain) (code 2797-N21) and adhered to the ethical principles outlined in the Declaration of Helsinki of the World Medical Association. All participants (and parents/ guardians of minors) provided informed consent prior to participation.

Table 1

Sociodemographic characteristics of the sample (N = 3,237)

Variables	Categories	*n*	%
Gender	Woman/Man/Non-binary	2117/ 1111/ 9	65.4/ 34.3/ 0.3
Marital status	Single/Married/Divorced/ Widowed	2203/887/123/24	68.1/27.4/3.8/0.7
Education	University/ High school/ Secondary/ Primary/None	2146/882/180/78/11	(66.3/25.4/5.6/2.4/0.4
Employment status	Student/ Unemployed/ Self-employed/	1827/246/146/901/60/57	56.5/7.6/4.5/27.8/3.6

	Employed/ Retired/Disabled		
Mental illness history	No/Yes	2318/919	71.6/28.4
Current psych. treatment	No/Yes	2795/442	86.3/13.7

Measures

Basic sociodemographic data sheet. A questionnaire developed by the authors was administered to collect the participants' sociodemographic variables, medication usage and psychopathological history. Then the evaluation instruments described below were administered.

Negative Symptoms Anticipation Scale (NSAS) The NSAS is an original self-report tool created by Rodríguez-Testal and Ceballos-Munuera to assess the anticipation or expectation of psychotic negative symptoms in social, affective, and motivational domains. This instrument is registered as intellectual property (42). It consists of 16 items, each rated on a 1 to 5 Likert scale indicating the degree of agreement, with 1 representing "strongly disagree" and 5 representing "strongly agree" (e.g., "*When I think about pending tasks and obligations, I immediately anticipate that I won't feel well while doing them*"). Factor analysis conducted by the authors identified three factors: anticipation of difficulties in social interactions (items 4, 3, 9, 10, 11, 15), in romantic relationships (1, 2, 8, 13), and low energy in daily activities (5, 6, 7, 12, 14, 16). The total scale score is obtained by summing all item responses. The scores demonstrated evidence of internal consistency (ordinal α = .949; α = .927, 95% *CI* [.923, .930]) and concurrent validity with other measures of negative symptoms was adequate. Both the Spanish and English versions are available in Appendices A and B of the Additional files 1 and

2. Further details on item construction and development are provided in Appendix C of the Additional file 3.

Depression Anxiety Stress Scales, (DASS-21) (43), Spanish version (44). This self-report measure assesses negative affect over one week, designed to measure the emotional states of depression, anxiety, and stress. It consists of 21 items with a four-choice Likert response format distributed across three subscales. In this study, only the depression subscale was used to test convergent and predictive validity. Here, internal consistency for depression was α = .926, 95% *CI* [.921, .931].

Self-evaluation of negative symptoms (SNS) (45), Spanish version (30). This self-report instrument is designed to assess the five dimensions of negative symptoms: social withdrawal, avolition, alogia, anhedonia, and diminished emotional range. The scale consists of 20 items with three response options (0 = "strongly disagree", 1 = "partially agree", 2 = "strongly agree"). For example, one item states: "I usually do not make an effort to contact or meet with friends (via letters, phone, text messages)." The total score is obtained by summing all item responses and it was used to test convergent and predictive validity. The SNS has demonstrated high reliability, with a Cronbach's alpha of .86 in the original study and .90 in its Spanish validation. For the current study, Cronbach's alpha was .883, 95% *CI* [.877, .889].

Schizotypal Personality Questionnaire – Brief Revised (SPQ-BR) (46), Spanish version (47). This 32-item questionnaire, featuring a Likert-type scale from 1 to 5 based on degree of agreement, is based on the concept of schizotypy and includes various scales, notably the reference ideas factor (e.g., "When shopping, do you get the feeling that other people are taking notice of you?"). The SPQ-BR was optimized for a hierarchical factor structure—

comprising three superordinate factors (i.e., positive, negative, disorganized) and seven subordinate factors (reflecting key facets of schizotypal personality traits). In this study, it was used to test convergent validity. Internal consistency scores of the instrument are good (α = .87); in the present study, SPQ-BR achieved α = .916, 95% *CI* [.912, .920].

Anticipatory and Consummatory Interpersonal Pleasure Scale (ACIPS) (48), Spanish version (49). This self-report measure consists of 17 items assessing individual differences in the capacity to enjoy interpersonal interactions. Interpersonal and social hedonic capacity is rated on a 6-point Likert scale, ranging from 1 ("totally false for me") to 6 ("totally true for me") (e.g., "When something good happens to me, I can't wait to share it with others"). Total scores range from 17 to 102, with lower scores indicative of a greater likelihood of social anhedonia. For this study, the ACIPS was employed to assess discriminant and predictive validity. Global internal consistency was good (α = .92); in this sample, α = .887, 95% *CI* [.878, .895].

ERIraos Checklist (50). The ERIraos Checklist is a screening instrument comprising 15 symptom descriptions. Respondents indicate whether they have experienced each symptom in the past 12 months (51). The checklist divides symptoms into three blocks: the first five items assess nonspecific mental health issues (e.g., mood, sleep); the second block queries five specific prodromal symptoms suggestive of increased psychosis risk; and the third block lists five symptoms characteristic of psychosis onset. The risk threshold is exceeded if a respondent answers "yes" to at least one item in either the second (prodromal) or third (psychosis onset) block (51). Maurer et al. (50) evaluated the predictive power of the checklist over one year, showing that participants with a total score ≥ 11 had a 30% transition rate to psychosis compared

to 14.3% for those scoring ≤ 10. The ERIraos Checklist has demonstrated reliability in several studies (52,53) and supports its use as a two-step tool for early recognition of psychosis risk. In this study, it was used to test the predictive capacity of NSAS for identifying individuals at risk or transitioning to psychosis.

Sincerity subscale of the Extroversion, Psychoticism, and Introversion Questionnaire (S-EPI) (41), Spanish version (54). The EPI assesses three personality dimensions based on Eysenck's theory, including an additional scale that measures response sincerity. The inventory has two parallel forms (A and B) to allow retest without memory effects; we employed Form A. For the current study, only the sincerity subscale (comprising nine true/false items) was used to evaluate the tendency to provide socially desirable responses. Items address daily life queries such as "*Have you ever been late for work, class, or an appointment*?" or "*Does your mood sometimes go up and down*?". Participants scoring below five on this subscale were excluded.

Moritz control scale. The response control scale of Moritz et al. (40) consists of four true/false items based on common myths about psychosis (e.g., "*It happened to me that I was abducted by aliens*"). Participants responding affirmatively to the control items were excluded.

Procedure and Pilot Study

Data were collected in two phases: a pilot study (with a one-month interval) and a validation study conducted in four waves. The scale was administered via an online link accessible from mobile devices, computers, tablets, and smartphones. The link provided detailed study information, presented the informed consent, guaranteed response anonymity, and allowed participants to withdraw at any time. The electronic questionnaire was structured to prevent

missing data, as participants were required to complete all items before submitting their responses.

No time limit was imposed for completing the tests, although the process was estimated not to exceed 40 minutes. Detailed instructions were provided prior to each test, and a response control system prevented participants from returning to previous items. Upon completion, responses were submitted in a single step, confirming their registration. To assess the temporal stability of the instrument, a second link was sent to participants two weeks after the initial NSAS administration in the pilot study.

The refinement of the NSAS was conducted in two phases. First, a qualitative analysis was performed during which five psychosis specialists (four clinical psychologists and one psychiatrist) collaborated in the initial drafting of items, which were then organized into six functional areas: social relationships, activities, romantic relationships, family, leisure/hobbies, and work/obligations. Subsequently, quantitative factorial adjustment techniques were applied. Exploratory Factor Analysis (EFA) identified three main factors (Social, Activities, and Romantic). As a result of the item purification process, items 1 and 22 were eliminated for not loading on any factor, and items 4 and 5 were removed due to collinearity and interpretative issues. In the Confirmatory Factor Analysis (CFA), three models were tested to improve fit indices (see Appendix C of Additional file 3, for complete details of the elimination criteria, CFA outputs, and the pre-purification solution). After eliminating items 7, 8, 14, 19, 20, 21, 23, and 25 due to poor fit, the final scale comprised 16 items, showing acceptable fit indices (*CFI* = .950; *TLI* = .941; *RMSEA* = .062; *SRMR* = .049). In the pilot study, reliability was assessed using Cronbach's alpha and test–retest correlations, which yielded high values in both pretest (α =

.947) and post-test (α = .966), indicating good internal consistency. Regarding concurrent validity, NSAS showed a high correlation with SNS (r = .638), supporting its utility as a measure of negative symptom anticipation. Correlations with the ACIPS were small but significant (NSAS total–ACIPS r = –.291; NSAS Social subscale–ACIPS r = –.270). These correlations are consistent with prior empirical and theoretical work showing that individuals with schizophrenia often experience reduced anticipatory pleasure—particularly in social contexts—when dysfunctional anticipatory cognitions or demotivating beliefs are present (55,56). Thus, higher anticipatory negative symptoms would be expected to relate to lower anticipated social pleasure. These findings indicate that NSAS assesses a related yet non-redundant construct compared with established measures of negative and social anhedonia. For a comprehensive account of item development, refinement, and validation, (see Appendix C of Additional file 3).

Statistical Analyses and Current Study

Descriptive analyses of the NSAS items were conducted. Normal distribution of continuous variables was verified using visual methods (histograms) and analytical tests, including the Kolmogorov–Smirnov (K-S) test. Although the K–S test indicated significant deviations from normality ($p < .001$), this test is highly sensitive in large samples and can detect trivial deviations. Therefore, we also considered skewness and kurtosis values (all items: skewness < 2, kurtosis < 3), which suggested approximate normality, as well as visual inspection of histograms. Given that the NSAS items are ordinal and to adopt a conservative approach in light of potential deviations from multivariate normality, nonparametric tests (e.g., Spearman correlations) were employed. The significance level was set at $p < .05$ for all inferential analyses.

To evaluate the internal factor structure of the definitive 16-item NSAS, a cross-validation factor analysis approach was intentionally employed to prevent overfitting. The total sample (N = 3,237) was randomly divided into two sub-samples using SPSS 26's random case selection procedure: Sample 1 (n = 1,623) for Exploratory Factor Analysis (EFA) and Sample 2 (n = 1,614) for Confirmatory Factor Analysis (CFA), ensuring that the CFA was conducted on an independent sample from the EFA, thus enabling cross-validation of the model.

In Sample 1, an EFA was conducted using the ordinary least squares method (*OLS*), given the ordinal nature of the data, with oblique promax rotation and a polychoric correlation matrix. In the current study, all items exceeded the factor loading threshold of .40, so no items were removed at this stage following the recommendations of Williams et al. (57). In Sample 2, several CFAs were conducted to verify the factor structure identified in the EFA, as well as its correspondence to the structure obtained in the pilot study (three factors) and a unidimensional version of the construct. Models were analyzed using robust diagonally weighted least squares (*RDWLS*), given the ordinal nature of the data and the violation of the multivariate normality assumption.

The goodness-of-fit of the CFA models was assessed using the following criteria: Comparative-Fit Index (*CFI*) ≥ 0.95, Tucker-Lewis Index (*TLI*) ≥ 0.95, Standardized Root Mean Square Residual (*SRMR*) ≤ 0.08, and Root Mean Square Error of Approximation (*RMSEA*) ≤ 0.06 with a 90% confidence interval.

To analyze measurement invariance of the NSAS model across gender, separate CFAs were conducted for males and females, followed by multigroup CFA. Chen's criterion was used to evaluate invariance, considering changes in CFI and RMSEA of less than .01 as indicating equivalence between groups (58). However, the non-binary group (n = 9) was not included in

this analysis due to its small sample size, which precluded reliable parameter estimation (59). Invariance across age was also assessed by dividing the total sample (N = 3,237) into three groups based on the mean and standard deviations: young (15–25 years, ≤ –1 SD), adults (26–45 years, mean ± 1 SD), and older adults (46–90 years, > +1 SD). This criterion allowed for balanced groups for robust analysis.

Reliability of NSAS scores was calculated using McDonald's Omega, Cronbach's Alpha, and Ordinal Alpha. To examine convergent and discriminant validity, bivariate Spearman correlations were performed between the total and subscale NSAS scores and other measures related to negative symptoms and anticipatory pleasure, including the SNS, ACIPS, SPQ-BR, and DASS-21. Correlation magnitudes were interpreted according to Cohen (60), where $r \geq .10$, .30, and .50 correspond to small, medium, and large effects, respectively.

Finally, predictive validity of the NSAS was evaluated using ROC (Receiver Operating Characteristic) curve analysis. Sensitivity, specificity, and positive and negative predictive values were calculated using the area under the ROC curve (*AUC*) as an indicator. According to Hosmer et al. (61) *AUC* values between 0.5 and 0.7 are considered poor, between 0.7 and 0.8 acceptable, between 0.8 and 0.9 excellent, and above 0.9 outstanding. Additionally, hierarchical regression analyses were conducted to determine whether NSAS (along with social anhedonia and depression) contributed to the variance of negative symptoms. Prior to these analyses, the assumptions of normality, homoscedasticity, linearity, and absence of multicollinearity were verified using VIF (variance inflation factors) and tolerance statistics. It was expected that VIF values would be below 10 and tolerance statistics above 0.2 (62). All statistical analyses were performed using SPSS v26.0, JASP v19.3 and Jamovi v2.6.25.

Results

Preliminary Analyses and Sample Characteristics

The total sample (N = 3,237) was divided into two sub samples for cross-validation. All sociodemographic characteristics and general NSAS measurements were equivalent between the groups ($p > .05$). Skewness was less than 2 and kurtosis less than 3 for all items. The Kolmogorov-Smirnov test indicated that the univariate distributions were not normal ($p < .001$); however, given the large sample size, this test is highly sensitive and trivial deviations from normality can produce significant results. All results are presented in Table 2.

Commented [CC1]: R2: The authors report skewness and kurtosis values within acceptable thresholds, but conclude non-normality based on the Kolmogorov–Smirnov test, which in very large samples is almost always significant. I suggest discussing this assessment more critically and clarifying which criteria underlie the choice to use nonparametric tests.

Table 2

Descriptive Statistics for the NSAS

Item	*M*	*SD*	*Skewness*	*Kurtosis*	*K-S (p)*
NSAS-1	2.011	1.248	.970	-.279	.296***
NSAS-2	2.103	1.248	.848	-.474	.260***
NSAS-3	1.753	1.072	1.391	1.053	.334***
NSAS-4	1.951	1.193	1.038	-.078	.298***
NSAS-5	2.412	1.344	.482	-1.064	.209***
NSAS-6	2.961	1.329	-.075	-1.185	.184***
NSAS-7	1.878	1.131	1.173	.375	.299***
NSAS-8	1.905	1.175	1.139	.210	.305***
NSAS-9	1.824	1.099	1.238	.582	.313***
NSAS-10	1.679	1.006	1.476	1.403	.351***
NSAS-11	1.751	1.103	1.424	1.058	.343***
NSAS-12	2.184	1.246	.716	-.670	.237***

NSAS-13	1.955	1.205	1.035	-.102	.302***
NSAS-14	1.862	1.155	1.215	.430	.316***
NSAS-15	1.874	1.100	1.124	.312	.296***
NSAS-16	2.087	1.191	.826	-.402	.250***

Note: $N = 3237$; *K-S*: Kolmogorov-Smirnov test for univariate normality; NSAS = Negative Symptoms Anticipation Scale; ***$p < .001$

Exploratory Factor Analysis (EFA)

In Sample 1 (n = 1,623), EFA yielded a Kaiser–Meyer–Olkin (*KMO*) value of .947 and significant Bartlett's Test of Sphericity ($\chi^2(120) = 19{,}756.117$, $p < .001$), indicating an adequate relationship among items for factor analysis. Mardia's test revealed significant deviations from multivariate normality in both skewness ($\chi^2(816) = 7133.925$; $p < .001$) and kurtosis ($Z = 94.032$, $p < .001$). Parallel analysis suggested a two-factor structure that explained 61% of the variance. The first factor grouped items related to the notion that performing daily or social activities requires excessive effort and anticipates low energy or motivation; we propose naming this factor "Anticipation of Low Energy and Social Demotivation". The second factor, which encompasses expectations of difficulties specifically in romantic relationships, was labeled "Anticipation of Difficulties in Romantic Relationships". The correlation between factors was .664. Supplementary Table 1 of Additional file 4 displays the factor solution and loadings for each item.

Confirmatory Factor Analysis and Measurement Invariance

Three models were explored in Sample 2 (n = 1,614) using CFA with robust diagonally weighted least squares (*RDWLS*), accounting for the ordinal data and non-multivariate normality. Although the EFA in the current sample suggested a two-factor solution, we retained the three-factor structure identified in the pilot study (social interactions, romantic relationships, and low energy in activities) for CFA. This decision was supported by several considerations. First, the three-factor model (Model 2) showed superior fit indices compared to the two-factor model (Model 1) (*CFI* = .997 vs. .992; *TLI* = .996 vs. .991; *RMSEA* = .025 vs. .037; *SRMR* = .036 vs. .047), indicating a better representation of the underlying construct. Second, the three-factor solution aligns with the conceptual distinctions observed in the pilot study (see Appendix C of Additional file 3 for more details), capturing relevant nuances in anticipatory negative symptoms across social interactions, romantic relationships, and energy/motivation in daily activities. Finally, retaining three factors enhances interpretability and clinical relevance, allowing for a more precise understanding of domain-specific anticipatory negative symptom patterns. In Model 2, items were specified to load on the three latent factors as defined in the pilot study (see Appendix D of Additional file 3), whereas in Model 3 all items were specified to load on a single latent factor to test whether a unidimensional structure provided a more parsimonious representation of the construct. This model (Model 2) was therefore selected for validation. Table 3 presents the fit indices for the models.

Table 3

Fit Indices of the CFA Models

	χ2	*df*	*p*	*CFI*	*TLI*	*RMSEA [CI 90%]*	*SRMR*

Model 1	335.538	103	< .001	.992	.991	.037 [.033, .042]	.047
Model 2	**199.495**	**101**	**< .001**	**.997**	**.996**	**.025 [.020, .030]**	**.036**
Model 3	850.615	104	< .001	.974	.971	.067 [.063, .071]	.074

Note: Model 1= EFA-derived two-factor mode; Model 2= pilot-study three-factor model; Model 3= unidimensional model. Values in bold indicate the selected model.

Measurement invariance of the NSAS was further examined (Supplementary Table 2 of Additional file 5) to determine whether the instrument functions equivalently across gender (males vs. females) and age (young vs. adults vs. older adults). For further details on group creation, refer to the Procedure section. Invariance was assessed using multigroup CFA at four levels: configural, metric, scalar, and strict, along with structural invariance to compare relationships between factors and differences in latent means and variances. Following Chen (58) and Cheung & Rensvold (63), *CFI* changes of less than .01 indicate invariance between groups. Results (Supplementary Table 2 of Additional file 5) revealed that although chi-square tests were significant in the total sample, *ΔCFI* was less than .01 in all cases, indicating invariance across gender and age groups.

However, in the structural invariance analysis by age, the change in CFI was –.013 and RMSEA increased by .019—values slightly above the recommended threshold. This suggests minimal differences in model structure between age groups, although within an acceptable range for comparing latent means and factor relationships. Additionally, chi-square tests were non-significant in the adult and older-adult groups, suggesting greater model stability in these age ranges.

Evidence of Reliability and Convergent Validity of the NSAS

The 16-item total scale demonstrated excellent internal consistency, based on Cronbach's alpha (α = .927) and McDonald's omega (ω = .926). Given the ordinal nature of the data, Ordinal Alpha for the total scale (α = .949) and individual factors (α-F1 = .925; α-F2 = .892; α-F3 = .901), was also calculated, indicating high internal consistency across the total scale and subscales. Temporal stability was evaluated and confirmed in the pilot study, showing a significant test–retest correlation (r = .762) and high intraclass correlations (Single *ICC* = .760; Average *ICC* = .863, $p < .01$). These values are reported here as evidence of the stability of the instrument over time.

To further support convergent and discriminant validity, Spearman correlations were examined between the NSAS and various measures of negative symptoms (SNS), schizotypy (SPQ), anticipatory pleasure (ACIPS), and depression (DASS-21) (see Table 4). As expected, the NSAS exhibited significant positive correlations with the SNS (r = .641), SPQ (r = .563) and DASS-21 (r = .523), supporting its convergent validity. Regarding schizotypy, the NSAS showed the strongest correlation with the SPQ negative subscale (r = .560), followed by the positive (r = .522) and disorganized (r = .473) subscales, consistent with theoretical expectations that the NSAS primarily captures anticipatory aspects of negative traits. According to Cohen's (2013) criteria (60), these correlations are of moderate to high magnitude ($r \geq .50$), indicating a strong relationship between the NSAS and established measures of negative symptoms and depression (60). Additionally, a moderate negative correlation was observed with the ACIPS (r = –.318), suggesting that higher NSAS scores are associated with lower anticipatory pleasure. The moderate magnitude of this correlation also supports the discriminant validity of the NSAS.

Table 4

Spearman correlations between NSAS and related measures: SNS (n = 3,110), SPQ (n = 3,110), ACIPS (n = 1,429), DASS-21 (n = 2,190)

	NSAS-total	F1-social	F2-partner	F3-energy
SNS	.641***	.571***	.479***	.598***
ACIPS	-.318***	-.359***	-.226***	-.263***
SPQ	.563***	.514***	.437***	.508***
SPQ-negative	.560***	.529***	.423***	.501***
SPQ-positive	.522***	.466***	.416***	.472***
SPQ-disorganized	.473***	.430***	.370***	.429***
DASS-21 (depression)	.523***	.437***	.373***	.532***

Notes: NSAS = Negative Symptom Anticipation Scale; SNS = Self-evaluation of Negative Symptoms, SPQ = Schizotypal Personality Questionnaire; ACIPS = Anticipatory and Consummatory Interpersonal Pleasure Scale; F1 = Anticipation of Social Difficulties; F2 = Anticipation of Relationship Difficulties; F3 = Anticipation of Low Energy; *** $p < .001$ (two-tailed).

Evidence of predictive validity

ROC Curve Analysis

A ROC curve was constructed to evaluate the sensitivity and specificity of the NSAS. A dichotomous variable was created based on two clinically relevant criteria: (a) a total score of 11 or more on the ERIraos Checklist, and (b) a score above the 85th percentile on the SNS (i.e., > 18 in our sample). The cutoff of 11 on the ERIraos was based on multicenter study data from

Maurer et al. (50), which showed a psychosis transition rate of 36% in individuals with ≥11 symptoms versus 12% in those with ≤10. This cutoff enabled the identification of participants at higher risk for transition. The SNS threshold was set based on the sample distribution, including subjects with significantly elevated negative symptom levels. Thus, participants meeting both conditions (ERIraos ≥11 AND SNS >85th percentile) were categorized into a "risk for psychosis transition" group (n = 24), whereas the remainder of the sample was classified as "no risk" (n = 737).

The ROC curve demonstrated a significant area under the curve for a cutoff score of ≥ 37 (*AUC* = .905 [*95% CI* = .862, .948]; see Figure 1). The NSAS cutoff of ≥37 was selected because it maximized the Youden Index (.692), providing the optimal balance between sensitivity and specificity. At this threshold, sensitivity was 100% (95% *CI* [.858, 1.00]), specificity was 69.2% (95% *CI* [.657, .725]), positive predictive value (PPV) was 9.56% (95% *CI* [.062, .139]), and negative predictive value (NPV) was 100% (95% *CI* [.993, 1.00]). This threshold best balanced the detection of individuals at risk for psychosis transition, maximizing both sensitivity and specificity. Considering the preventive and early-intervention focus of the NSAS, priority was placed on maximizing sensitivity to ensure that at-risk individuals are identified.

Given that the total SNS score also includes the expressive deficit component, which is theoretically less directly related to anticipatory processes, we further examined predictive validity using a dichotomous risk variable based on ERIraos ≥11 combined with only the motivational deficit components of the SNS (abulia, anhedonia, and social withdrawal subscales; score above the 85th percentile, i.e., > 11 in our sample). Using this definition, the NSAS cutoff of ≥37 remained optimal, with sensitivity = 100%, specificity = 69.2%, and Youden Index =

.692. The area under the curve increased slightly (*AUC* = .910), supporting the robustness of the predictive validity of the NSAS and its theoretical alignment with anticipatory processes.

To increase transparency, we provide in the Additional file 6 (Appendix D) the full confusion matrices (TP, FP, FN, TN) and derived metrics for the tested cutoffs (35–38), as well as the distribution of NSAS scores by group (risk vs. no risk) with robust mean estimators. In addition, Appendix D includes the ROC curve using the motivational deficit component of the SNS (score > 11) for comparison with the original analysis.

To confirm the robustness of the predictive validity metrics given the unbalanced group sizes, we performed a bootstrap procedure with 1,000 and 5,000 resamples. Results were highly consistent with the original estimates, with the area under the curve, sensitivity, and specificity showing minimal variation. In addition, bootstrap-based CIs for the AUC supported the stability of the estimates (*AUC* = .905, 95% *CI* [.862, .948]). This confirms that the selected NSAS cutoff (≥37) reliably maximizes the Youden Index. Sociodemographic characteristics by risk group, based on the established cutoff, are presented in Table 5.

Table 5

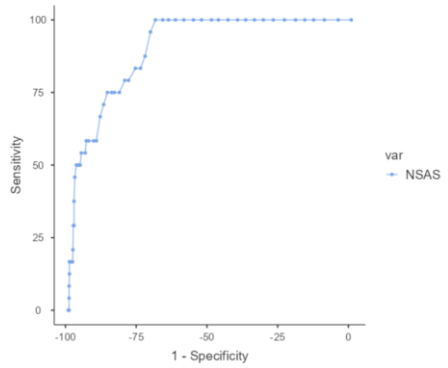
Sociodemographic Characteristics of Participants by Psychosis Risk Group (*N* = 3237)

Group	*N*	% Gender			Age		NSAS
		Male	Female	Non-binary	*M* (*SD*)	*Mdn*	*M (SD)*
No risk (NSAS <37)	2161	36.1	63.7	.2	31.41 (14.93)	23	24.47 (5.96)
At Risk for Psychosis Transition (NSAS ≥ 37)	1076	30.7	68.9	.5	29.39 (14.37)	22	47.70 (8.96)

Note. Composite criterion for risk = ERIraos ≥11 and SNS >85th percentile

Figure 1

ROC Curve for Identifying Individuals at Risk for Psychosis Transition Based on NSAS (Cutoff ≥ 37; AUC = .905)



Hierarchical Regression Analyses

Based on significant correlation results (see Table 4), two hierarchical regression analyses were conducted to explore whether anticipatory negative symptoms (NSAS) explained additional variance in negative symptoms (SNS), beyond typically associated factors (social anhedonia and depressive symptoms). In line with the previously described criteria, there were no issues regarding multicollinearity among our predictors in either model (tolerances > .65; *VIF* < 2).

*Regression Analysis 1***:** Social anhedonia (ACIPS) was entered in the first step, followed by NSAS in the second. Social anhedonia accounted for 20.6% of the variance in negative symptoms [F (1,1427) = 370.95, p < .001]. With the addition of NSAS, both variables together explained 45.1% of the variance, with NSAS uniquely accounting for 24.5% of the variance in SNS [F (2,1426) = 585.38, p < .001]. Both predictors remained significant in the final model, with NSAS exhibiting a larger standardized beta (β = .284, p < .001) compared to ACIPS (β = –.196, p < .001), indicating that anticipatory negative symptoms are a stronger predictor of negative symptoms than social anticipatory pleasure.

Regression Analysis 2: A more stringent hierarchical regression was then performed. In the first step, social anhedonia and depressive symptomatology were entered as predictors, jointly explaining 45.9% of the variance in negative symptoms [F (2,1426) = 604,62, $p < .001$]. In the second step, NSAS was added, resulting in a significant increase in variance explained to 53.1% [F (3,1425) = 536,90, $p < .001$], representing a 7.2% improvement in R^2 [$\Delta R^2 = .072$, $p < .001$]. In the final model, all predictors were significant, with NSAS emerging as the second most important predictor ($\beta = .331$, $p < .001$), second only to depression ($\beta = .339$, $p < .001$) and above ACIPS ($\beta = –.298$, $p < .001$). These findings indicate that, even when controlling for social anhedonia and depressive symptoms, the anticipatory component assessed by the NSAS uniquely and significantly contributes to the prediction of negative symptoms.

Discussion

Negative symptoms play a key role in the early detection and prevention of psychosis, as they typically precede the emergence of positive symptoms. Longitudinal evidence suggests that, within community populations, negative traits often manifest before positive symptoms (64). Furthermore, follow-up studies have shown that negative symptoms can emerge more than two years before the onset of positive symptoms in schizophrenia (65). This progression highlights the importance of early evaluation of potential negative symptom emergence, which could improve early detection and support the development of preventive interventions. In this context, developing and validating a specific scale to measure the anticipation of negative symptoms represents a notable advance in assessing psychosis risk and planning intervention strategies. The present study's primary objective was to develop and validate the 16-item Negative Symptoms Anticipation Scale (NSAS), a self-report instrument designed to assess expectations and anticipatory processes related to negative symptoms in psychosis. The results underscore the

importance of cognitive processes, particularly those described in Beck's model (14,15), in the genesis and maintenance of these symptoms.

A key aspect of this study was validating the NSAS in a young, general population sample—a decision grounded in accumulating evidence regarding the relevance of subclinical negative symptoms for detecting psychosis risk and their presence beyond schizophrenia. Using a general population sample with varying degrees of vulnerability to negative symptoms is justified not only because subclinical negative symptoms have been considered a low-threshold criterion in high-risk studies (35–37) but also due to their continuity in the general population (33,36). In our study, 482 participants scored above the 85th percentile on the total SNS, with a mean age of 28.47 years, highlighting the importance of evaluating these symptoms even in nonclinical samples. This finding is consistent with previous research indicating that approximately 20% of adolescents and young adults (25–34 years) exhibit attenuated negative symptoms (29,30).

Psychometrically, the NSAS exhibited excellent internal consistency, supporting its reliability in measuring the proposed construct. Both the EFA and CFA demonstrated a robust factor structure, with the three-factor version—encompassing dimensions of anticipation of difficulties in social interactions, romantic relationships, and low energy in daily activities—yielding superior fit indices.

The three-factor structure identified—comprising anticipated difficulties in social interactions, romantic relationships, and low energy in daily activities—suggests that anticipatory cognitions about negative symptoms may manifest across distinct but interrelated functional domains. Although Beck's cognitive model of negative symptoms (14,66) does not

explicitly delineate separate dimensions of anticipation across specific life contexts, the observed structure is conceptually consistent with its core principles. In particular, cognitive models emphasize the role of dysfunctional expectations, anticipatory beliefs, and defeatist attitudes in shaping motivation, effort allocation, and social engagement. These maladaptive expectations—whether related to anticipated failure, rejection, or limited reward—may diminish anticipatory pleasure and goal-directed behavior, thereby sustaining social withdrawal and reduced activity.

Importantly, the NSAS captures anticipatory cognitions regarding the likelihood of experiencing negative symptoms themselves (e.g., demotivation, reduced energy, or social disengagement), rather than broad self-evaluative judgments or general beliefs about personal worth. Although some items may involve anticipating difficulties or reduced capacity (e.g., "I won't be able…"), these reflect expectations about symptom-related functioning rather than global self-judgments or inferences about incapacity. Clarifying this distinction helps to situate negative symptom anticipation as a specific cognitive process related to the expected emergence of symptoms, rather than as an indicator of broader dysfunctional beliefs.

Conceptually, the NSAS specifically targets these anticipatory cognitions related to negative symptoms, rather than the symptoms themselves or broader dysfunctional beliefs such as defeatist attitudes. While its items reflect anticipated difficulties across social, romantic, and energy-related domains, they all operationalize the same central construct of anticipatory negative symptom cognition. This distinction clarifies the unique contribution of the NSAS and supports its value as a tool for identifying domain-specific anticipatory patterns that precede or maintain negative symptoms.

Clinically, distinguishing these domains may help tailor interventions targeting specific anticipatory biases—for instance, addressing anticipated social rejection in social skills training, or low perceived energy in behavioral activation programs. Thus, the NSAS may serve as a useful tool for identifying domain-specific anticipatory patterns that precede or maintain negative symptoms, informing personalized preventive and therapeutic approaches.

Convergent and discriminant validity were further confirmed via moderate to high correlations with established measures of negative symptoms, schizotypy, and depression, alongside negative associations with anticipatory pleasure. Invariance analyses suggest that the NSAS functions equivalently across gender and age, reinforcing its validity for group comparisons. The stability of the factorial structure in both males and females indicates that the construct of negative symptom anticipation is measured consistently, allowing direct comparisons without methodological bias. However, the small nonbinary sample size precluded their inclusion in these analyses. Analyses specific to gender identity could provide important insights, as socialization, gender-related expectations, and minority stress experiences may influence the anticipation of difficulties in social or romantic contexts. While our study could not examine this group, epidemiological work indicates higher rates of psychotic disorder diagnoses among transgender compared to cisgender individuals, highlighting the potential impact of minority stress and the importance of culturally- and gender-affirming approaches in research and clinical practice (67). These findings emphasize the need for future studies with more diverse gender representation to fully assess the applicability and measurement properties of the NSAS across all gender identities.

Regarding age invariance, while results largely support measurement equivalence across young, adult, and older adult groups, slight differences in structural invariance were observed. This suggests that although the general model remains intact, subtle variations in the manifestation or interpretation of negative symptoms across the lifespan may exist. These findings are relevant as negative symptoms may present differently at various developmental stages, potentially influencing their detection and treatment. Notwithstanding these nuances, the results support the utility of the NSAS for assessing negative symptom anticipation across a broad age range, with caution advised when interpreting comparisons between age groups, particularly in clinical or longitudinal studies.

Complementing these findings, the NSAS's predictive capacity was demonstrated through ROC analysis, which yielded an outstanding area under the curve for discriminating between individuals at low and high risk of transition to psychosis at a cutoff score of 37 or greater. Furthermore, hierarchical regression analyses reinforce the significance of the anticipatory component in understanding negative symptoms. In the first model, NSAS uniquely accounted for an additional 24.5% of the variance in negative symptoms beyond social anhedonia, emerging as the strongest predictor. In a more stringent model controlling for depressive symptoms, NSAS still contributed a significant additional 7.2% variance, ranking as the second most important predictor. These outcomes affirm that the NSAS not only precisely captures the anticipation of negative symptoms but also offers unique and clinically relevant incremental value for early psychosis risk detection and intervention.

From a theoretical standpoint, these findings support cognitive models that posit dysfunctional beliefs and negative expectations play a critical role in the development and

exacerbation of negative symptoms. For instance Pillny et al. (56) demonstrated that demotivating beliefs interfere with anticipatory pleasure, thereby affecting goal-directed behavior in patients with negative symptoms of psychosis. That study suggests that negative expectations regarding future success and pleasure may prevent patients from engaging in social and self-care activities. By incorporating the anticipatory dimension, the NSAS expands our understanding of the underlying mechanisms in psychosis and opens new avenues for targeted cognitive interventions.

Limitations and Future Studies

Despite promising results, several limitations warrant consideration. The use of non-probabilistic convenience and snowball sampling may limit the representativeness and generalizability of findings to other populations and clinical contexts. Although employing a general population sample is appropriate for initial validation, it is crucial to replicate these findings in clinical samples—particularly in individuals diagnosed with psychosis or schizophrenia, where negative symptoms are more severe, chronic, and associated with functional deterioration. Additionally, the small number of nonbinary participants precluded their inclusion in invariance analyses, indicating a need for future studies with a more balanced gender representation. The sample was predominantly composed of students and young adults, which might have influenced response variability and limits applicability to other age groups or populations with greater cognitive or functional impairment. Moreover, the cross-sectional design of the study prevents establishing causal relationships between anticipatory cognitions and negative symptoms, limiting our understanding of the directionality of these associations.

Furthermore, it remains unexplored whether the anticipatory negative symptoms assessed by the NSAS differentially relate to primary negative symptoms—intrinsic to the disorder—and secondary negative symptoms, which may arise from factors such as depression, antipsychotic side effects, anxiety, or positive symptoms. This distinction is particularly relevant for phenomena like anhedonia, which may have a structural origin or serve as an adaptive response to threatening internal experiences (e.g., isolation due to paranoid ideation). Existing literature suggests that some negative symptoms emerge early, even before prolonged antipsychotic exposure, reinforcing the hypothesis of a primary base in certain cases. However, the absence of validated tools to differentiate primary from secondary negative symptoms limits current diagnostic precision and therapeutic guidance.

Finally, although the present study involved a non-clinical sample with minimal exposure to antipsychotic medication, future research in clinical populations should further explore the potential impact of pharmacological treatment. Side effects such as blunted affect, fatigue, or apathy may induce or exacerbate negative symptoms, creating a feedback loop that affects anticipatory cognition and overall functioning. Studies should therefore carefully control for treatment-related variables, including type, dosage, and duration of medication, when examining these interactions.

Based on the identified findings and limitations, future research should adopt longitudinal designs to examine the stability of the NSAS construct over time and causally evaluate the influence of negative expectations on the development and exacerbation of negative symptoms. Studies should include more heterogeneous and representative samples in terms of age, cultural

diversity, and gender. Cross-cultural and linguistic validations of the NSAS would also help determine its global applicability and robustness across different settings.

Additionally, applying the NSAS in clinical populations—particularly in early-stage psychosis or at-risk individuals—could provide valuable insights for developing targeted interventions. Incorporating the NSAS into early detection and follow-up protocols could further evaluate its practical utility in clinical management. Given that both anticipatory pleasure and the generation of expectations are linked to cognitive and affective processes, integrating the NSAS with neurocognitive and emotional processing assessments may further elucidate underlying mechanisms and enable the development of more precise risk and dysfunction profiles. Including objective clinical measures to differentiate between primary and secondary negative symptoms will be key to advancing a more nuanced understanding of the phenomenon and informing personalized therapeutic decisions.

Conclusions

In summary, the NSAS emerges as a promising tool for the evaluation of anticipatory processes in psychosis, distinguished by its solid theoretical underpinnings, robust psychometric properties, and excellent predictive capacity. To enhance its practical applicability and external validity, future research should focus on: (1) replicating the instrument's validity in clinical samples with varying levels of functional impairment; (2) integrating objective clinical measures to differentiate primary from secondary negative symptoms, thereby providing greater diagnostic and therapeutic value; (3) considering the effects of antipsychotic medication as a potential mediating or moderating variable given its influence on negative symptomatology; and (4)

employing longitudinal designs to explore developmental trajectories and establish causal relationships between anticipatory processes and the emergence of negative symptoms.

Consent to Participate: Informed consent was obtained from all individual participants included in the study.

Ethics Approval: The study was approved by the Clinical Research Ethics Committee of the Junta de Andalucía (Spain) (code 2797-N21).

Human Ethics and Consent to Participate declarations: Ethics approval was obtained from Clinical Research Ethics Committee of the Junta de Andalucía (Spain) (code 2797-N21). Informed consent was obtained from all participants.

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