

A Psychometric Comparison of the Clinical Assessment Interview for Negative Symptoms and the Brief Negative Symptom Scale

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In 2005, the National Institute of Mental Health held a consensus development conference on negative symptoms of schizophrenia. Among the important conclusions of this meeting were that there are at least 5 commonly accepted domains of negative symptoms (blunted affect, alogia, avolition, anhedonia, asociality) and that new rating scales were needed to adequately assess these constructs. Two next-generation negative symptom scales resulted from this meeting: the Brief Negative Symptom Scale (BNSS) and Clinical Assessment Interview for Negative Symptoms (CAINS). Both measures are becoming widely used and studies have demonstrated good psychometric properties for each scale. The current study provides the first direct psychometric comparison of these scales. Participants included 65 outpatients diagnosed with schizophrenia or schizoaffective disorder who completed clinical interviews, questionnaires, and neuropsychological testing. Separate raters completed the BNSS and CAINS within the same week. Results indicated that both measures had good internal consistency, convergent validity, and discriminant validity. High correspondence was observed between CAINS and BNSS blunted affect and alogia items. Moderate convergence occurred for avolition and asociality items, and low convergence was seen among anhedonia items. Findings suggest that both scales have good psychometric properties, but that there are important distinctions among the items related to motivation and pleasure.

Key words: psychosis/negative symptoms/assessment

Introduction

In 2005, the NIMH held a consensus conference on negative symptoms of schizophrenia.¹ Several important conclusions resulted from this meeting. Among those conclusions were that: (1) there are at least 5 negative symptom domains (blunted affect, alogia, avolition,

anhedonia, asociality); and (2) there is a clear need for the development of new negative symptom rating scales designed to assess these 5 domains, which should exclude content not representative of the negative symptom construct (eg, poverty of content of speech, attention) and incorporate recent findings from the fields of psychopathology and affective science (eg, anticipatory vs consummatory pleasure distinction).¹ A working group was formed at the 2005 conference to develop a new state-of-the-art negative symptom scale. This group worked together to develop a beta measure. However, at that time, it became clear that multiple measures were needed to fulfill the diverse needs of the field and 2 groups separated to create distinct next-generation scales. One group pursued the rapid dissemination of a shorter measure, the Brief Negative Symptom Scale (BNSS²), which was designed for ease of use in clinical trials and validated over a series of studies. Another group pursued creation of an empirically based psychometric scale, the Clinical Assessment Interview for Negative Symptoms (CAINS³), which was developed using an iterative analytic approach across multiple studies that spanned several years. Both measures have received considerable attention and are becoming widely adopted.⁴

Table 1 summarizes information related to the 2 measures, including key scale features, item content, and psychometric properties. As can be seen in table 1, there are several important similarities and differences between the CAINS and BNSS. Both scales contain 13 items and cover the 5 core negative symptom domains (blunted affect, alogia, avolition, anhedonia, asociality). The BNSS also covers pathological lack of normal distress, which is a symptom frequently exhibited by patients with primary and enduring negative symptoms (ie, the deficit syndrome).^{5,6} Comprehensive manuals and workbooks that provide semi-structured interviews and suggested prompts are available for each scale. The CAINS manual

Table 1. Summary of CAINS and BNSS Scale Features, Item Content, and Psychometrics

	BNSS	CAINS
Scale features		
Number of items	13 items	13 items
Interview length	Average 12 min, range ~10–15 min	Average 22 min, range ~15–30 min
Materials	Manual (9 pgs), workbook, scoresheet	Manual (31 pgs), workbook, scoresheet
Domains covered	Blunted affect, alogia, anhedonia, avolition, asociality, lack of normal distress	Blunted affect, alogia, anhedonia, avolition, asociality
Training materials	Gold-standard videos available for qualified professionals by contacting the authors; professional training for commercial use offered via Prophase	Gold-standard videos available online for qualified professionals at UPENN website
Translations	Completed: Italian, Spanish, German, Turkish; In Progress: Korean, Mandarin, Danish; Portuguese	Completed: Spanish, German, Mandarin, Cantonese, Korean, French, Czech; In Progress: Polish, Greek, Swedish
Item content		
Anhedonia items	3 separate items measuring intensity of past pleasure, frequency of past pleasure, and intensity of future pleasure; all 3 items evaluate recreational, social, work/school, and physical pleasure within the same item. No items for frequency of future pleasure. The frequency item does not rely on a precise count of activities over the past week, but rather a global consideration of behavior relative to that person's demographic.	5 items; 2 measuring frequency of past week recreational and social activities; 3 measuring expected frequency of pleasurable work/school, social, and recreational activities; no items for physical pleasure. Requires the patient to extensively review the activities of each day of the week and the rater bases their rating on the precise number of activities completed or expected over that week. Past week recreational pleasure also evaluates diversity of activities that were pleasurable.
Avolition items	Separate items for avolition internal experience and avolition behavior; both items cover motivation for work/school, recreational activity, self-care, and general time spent in inactivity.	4 items; Separate items for motivation at work/school, recreational activities; family/spouse relationships, and close friendship/romantic partner relationships. Inner-experience and behavior are rated within a single item, not separated out. No coverage of self-care.
Asociality items	Separate items for asociality inner-experience and behavior. No separate items for family/spouse/partner and friends—these are all considered together.	Based on item-response theory analyses, asociality items were subsumed under motivation for social relationships.
Blunted affect items	Separate items for facial expressivity, vocal expressivity, and body gestures. Vocal intonation focuses on modulation of speed, volume, and pitch.	Separate items for facial expressivity, vocal expressivity, and body gestures. Vocal intonation focuses on pitch.
Alogia items	Separate items for quantity of speech and spontaneous elaboration	Single item for quantity of speech. Spontaneous elaboration not rated.
Lack of normal distress items	1 item intended to capture pathological reduction in frequency and duration of negative emotion; useful for separating “deficit” (ie, primary and enduring negative symptoms) and nondeficit schizophrenia.	Not rated.
Psychometrics		
Inter-rater reliability	ICC = 0.96 to 0.98 for total score; 0.98 for EXP; 0.94 for MAP	0.97 for total score; 0.93–0.97 for MAP; 0.77–0.95 for EXP
Internal-consistency	Chronbach's alpha .93 to .94 for total score	Chronbach's alpha .93 for total, .87–.93 for MAP and .80–.93 for EXP
Test–retest reliability	$r = .93$ for total score, .88 for EXP and .92 for MAP	$r = .69$ for MAP and .69 for EXP
Convergent validity	Moderate to high correlations between BNSS total and SANS, BPRS and PANSS factors, and community-based functional outcome; Moderate correlation between BNSS total and cognition	MAP and EXP scales moderately correlated with SANS total and BPRS negative factor, community based functional outcome; MAP moderately correlated with TEPS consummatory and anticipatory subscales and Chapman Scale social anhedonia; EXP significantly correlated with experimenter coded facial expressions; correlations with cognition and functional capacity nonsignificant.

Table 1. Continued

	BNSS	CAINS
Discriminant validity	Low to null correlation between BNSS total and BPRS or PANSS positive, disorganized, and depression scores	MAP and EXP low to nonsignificant correlations with BPRS positive symptoms, depression, agitation, extrapyramidal symptoms
Factor structure	English, Italian, and German versions = 2 factors: Emotional expressivity (alogia, blunted affect), Motivation and Pleasure (anhedonia, avolition, asociality); Spanish version = 3 factors, inconsistent with other versions	English, German, and Spanish versions = 2 factors: Emotional expressivity (alogia, blunted affect), Motivation and Pleasure (anhedonia, avolition, asociality); Chinese version, factor solution inconsistent with other versions

Note: ICC, Intraclass correlation coefficient; TEPS, Temporal Experience of Pleasure Scale; CAINS, Clinical Assessment Interview for Negative Symptoms; PANSS, Positive and Negative Syndrome Scale; BNSS, Brief Negative Symptom Scale; BPRS, Brief Psychiatric Rating Scale; EXP, Emotional Expressivity Subscale (blunted affect, alogia); MAP, Motivation and Pleasure Subscale (anhedonia, avolition, asociality); BNSS and CAINS interview times based upon estimates reported by the authors of the scales that were derived from validation studies.

provides illustrative vignettes, whereas the BNSS does not. Interview time differs between the scales, with the BNSS averaging 10–15 minutes and the CAINS 15–30 minutes according to estimates from the authors of each scale. Training materials, including gold-standard videos, are available for both scales to facilitate their use in clinical trials and experimental psychopathology studies (see Carpenter et al⁴). Items on the scales can be reliably assessed across cultures, and translations of the CAINS and BNSS have been successfully accomplished in several languages already (table 1).^{7–14}

Initial pilot studies on the BNSS² and CAINS¹⁵ reported the development of the instruments, preliminary psychometric properties in small samples, and inter-rater reliability. Subsequent validation studies were conducted with larger samples for both scales (CAINS: $ns = 281, 162$ ^{16,17}; BNSS $ns = 100, 146$).^{5,18} The large-scale validation studies indicate that the psychometric properties of both scales are generally good. Inter-rater reliability and internal consistency are high on both scales. Test–retest reliability is high on the BNSS and adequate on the CAINS.^{5,16} Both measures demonstrate good convergent validity with other negative symptom (eg, SANS, PANSS, BPRS) and functional outcome scales.^{2,5,12,16,17} Both scales predict impairment on objective measures of reward and emotion processing in experimental psychopathology studies.^{19–24} The BNSS also demonstrates a significant association with cognition and neuropsychological effort testing^{5,25}; the CAINS has not been significantly associated with cognition in studies to date.^{16,17} Good discriminant validity has been shown for the CAINS and BNSS, as indicated by low or nonsignificant correlations with psychosis and disorganization.^{2,5,16,17} In the English versions of the scales, a 2-factor solution has been demonstrated on both measures, with factors reflecting motivation and pleasure (MAP: anhedonia, avolition, asociality) and diminished expressivity (EXP: blunted affect, alogia).^{16–18} On both scales, MAP and EXP may represent separable treatment targets with distinct etiologies.^{26,27}

Regarding item content, the blunted affect and alogia items are fairly similar on the 2 scales. Minor differences include rating modulation of speed, volume, and pitch on the BNSS Vocal Expression item, and only pitch on the CAINS vocal expression item. The CAINS alogia item evaluates quantity of speech, whereas the BNSS has separate items for quantity of speech and spontaneous elaboration (ie, giving information beyond what is strictly necessary to answer the questions). Asociality items on both scales evaluate the degree of interest in and desire for social relationships, as well as how often patients actually engage in social interactions. A key difference is that the CAINS has separate items for close friendships/romantic relationships and family/spouse/partner relationships. The BNSS considers all relationship types in total. Another key difference between the scales is that the CAINS evaluates desire for social interaction and social behavior within a single item, whereas the BNSS has separate items for internal experience and overt behavior. Dissociations between these 2 BNSS asociality items have been shown to predict clinical outcomes.⁵ The avolition items on both scales rate the extent to which patients report initiating and persisting in goal-directed activity and how much they desire to do so. The CAINS evaluates the extent to which patients desire and engage in work/school and recreational activities. The BNSS has separate items for internal experience (ie, desire/wanting) and overt motivated behavior, and considers the domains of self-care, work/school, recreational activities, and the general amount of time spent in passive inactivity.

The largest difference in content involves the anhedonia items. The CAINS anhedonia items evaluate frequency of pleasure experienced over the past week and frequency of expected future pleasure over the next week. CAINS interviewers review the past week with the patient and count the number of pleasurable activities reported for recreational activities and social interactions. For recreation past week pleasure, the CAINS also assesses the diversity of

experiences that were pleasurable. The CAINS anticipatory pleasure items evaluate the number of enjoyable activities that patients say they expect to experience throughout the next week in relation to social and recreational domains. Interviewers do not prompt the patient to report about specific activities that they know the patient experiences— the items are designed to assess a patient's ability to spontaneously generate predictions of how many pleasurable activities they will experience. There is no threshold of pleasure intensity that determines whether an experienced or expected event is pleasurable on the CAINS—minimally and intensely pleasurable activities are treated similarly. The CAINS anhedonia items therefore focus on frequency of expected and remembered pleasure, not intensity. In contrast, BNSS anhedonia items evaluate intensity of pleasure over the past week and intensity of expected future pleasure. There is also a BNSS item for frequency of pleasurable activities over the past week. The BNSS does not evaluate frequency of expected future pleasure, only intensity. The timeframe for future activities is not limited to 1 week on the BNSS, but rather is open to all future events. For the anticipatory pleasure item, BNSS interviewers are instructed to ask about activities patients have reported engaging in (ie, prompting is encouraged). Whereas the CAINS has separate items for frequency of pleasurable social and recreational activities, the 3 BNSS anhedonia items each consider these activity types within each item. The BNSS also rates a fourth activity type that has been shown to be a core aspect of anhedonia, physical pleasure, within each of the 3 anhedonia items.

Despite clear similarities and differences between the 2 next-generation negative symptom scales, a direct psychometric comparison of the BNSS and CAINS has yet to be accomplished. Here, we report the results of a study that obtained ratings on both scales, which were completed by 2 different raters who evaluated outpatients within the same week. We were primarily interested in the convergence between individual BNSS and CAINS items, as well as the EXP subscales, MAP subscales, and total scores. Additional analyses are reported to compare internal consistency, discriminant validity, and convergent validity using several clinical rating scales, questionnaires, and neuropsychological tests. Findings may provide the field with important guidance regarding the advantages and disadvantages of each scale, as well as the research contexts that the scales may be best suited for. We hypothesized moderate to high correlations between all BNSS and CAINS items from the same construct, as well as EXP, MAP, and total scores. Both scales were expected to have good convergent and discriminant validity based on prior psychometric studies.^{5,16}

Method

Participants

Participants included 65 outpatients diagnosed with schizophrenia or schizoaffective disorder who were

recruited from the outpatient research clinics at the Maryland Psychiatric Research Center (MPRC), a research clinic within the Department of Psychiatry at the University of Maryland School of Medicine. All participants were evaluated during a period of clinical stability, as defined by no change in dose or type of medication over a period of 4 weeks prior to the evaluation. Diagnosis was established via a best-estimate approach based on psychiatric history, multiple interviews, family informants, and the Structured Clinical Interview for DSM-IV.²⁸ Exclusion criteria consisted of substance abuse or dependence in the past 6 months and history of neurological disorder or head injury resulting in loss of consciousness, hospitalization, and resulting concussion symptoms.

On average, participants were 40.11 (11.2) years of age, had 13.0 (2.1) years of personal and 13.84 (3.0) years of parental education, 73.8% were male, and 55.4% were Caucasian, 33.8% African American, 3.1% Asian, 3.1% American Indian, 1.5% Mixed race, and 3.1% Other race. Participants were prescribed a combination of second-generation antipsychotics alone, first-generation antipsychotics alone, or multiple antipsychotics.

Procedures

A battery of psychiatric rating instruments, questionnaires, and neuropsychological tests was administered, including: (1) Clinical Assessment Interview for Negative Symptoms (CAINS)³; (2) Brief Negative Symptom Scale (BNSS)²; (3) Scale for the Assessment of Negative Symptoms—22 item version (SANS)^{29,30}; (4) Brief Psychiatric Rating Scale (BPRS)³¹; (5) Level of Function Scale (LOF)³²; (6) Revised Chapman Social and Physical Anhedonia Scales³³; (7) Defeatist Performance Beliefs Scale (DPB)³⁴; and (8) MATRICS Consensus Cognitive Battery (MCCB).³⁵

Initial BNSS and CAINS training was provided by authors who developed each of those scales (BNSS = Strauss; CAINS = Blanchard). Rater training consisted of an in-depth review of the manual for each measure, as well as procedures for rating the instrument. Raters watched and rated a series of initial videos developed by the BNSS and CAINS authors. Ratings were then discussed as a group using gold-standard rationales and interviewers were instructed in interview technique. Interviewers subsequently received ongoing supervision and participated in regular gold-standard reliability meetings to maintain quality assurance. An MPRC therapist that had no investment or conflict with either the BNSS or CAINS performed ongoing supervision and gold standard training. Interviews were conducted by experienced raters who met minimum reliability standards on the clinical rating instruments (inter-rater agreement >0.80 using gold-standard training tapes).

For practical purposes, the rater who completed the BNSS also completed the SANS, BPRS, and LOF (total combined

interview length ~30–45 min). A separate rater completed the CAINS (interview length ~30 min) on a different day within 1-week of the BNSS, BPRS, SANS, LOF interview. Raters completing the BNSS and CAINS rotated. Raters were typically familiar with the patients whom they interviewed and had often rated them as part of previous studies.

Results

Descriptive Statistics and Distribution of Scores

Table 2 presents descriptive statistics for the BNSS and CAINS items and subscales. On the BNSS, lack of normal distress, spontaneous elaboration, and quantity of speech had skew > 1.0. On the CAINS, expected pleasure at work and school had skew < -1.0 (table 2).

Convergence Between BNSS and CAINS Items, Subscales, and Total Scores

Table 3 presents correlations between individual BNSS and CAINS items. Of greatest interest were the correlations between items intended to cover similar constructs. BNSS and CAINS anhedonia items showed relatively low

correlations on average, with some nonsignificant correlations between anticipatory pleasure items. Avolition and asociality items on the BNSS and CAINS were generally moderately to highly correlated. Blunted affect and alergia items were highly correlated.

The MAP ($r = .67$) and EXP ($r = .78$) subscales of the 2 measures were highly correlated, as were the total scores ($r = .77$).

The BNSS lack of normal distress item significantly correlated with the CAINS MAP ($r = .41, P < .001$) and EXP ($r = .50, P < .001$) subscales.

Internal Consistency

Cronbach's alpha was .94 for the BNSS and .88 for the CAINS, indicating excellent internal consistency on both scales.

Item-Total Correlations and Alpha-if Item Deleted Coefficients

Item total correlations indicated that all BNSS (range $r = .58$ to $.87$) and all CAINS (range $r = .35$ to $r = .83$)

Table 2. Descriptive Statistics for BNSS and CAINS Items, Subscales, and Totals

	Mean	SD	Range	Skewness	Kurtosis
BNSS					
1. Intensity of pleasurable activities	1.38	1.37	0–4	0.48	-1.01
2. Frequency of pleasurable activities	2.32	1.53	0–5	-0.03	-0.83
3. Intensity of future pleasure	1.43	1.33	0–5	0.34	-0.96
4. Lack of normal distress	1.22	1.64	0–6	1.17	0.34
5. Asociality behavior	2.22	1.33	0–5	0.21	-0.25
6. Asociality internal experience	1.72	1.35	0–5	0.64	0.17
7. Avolition behavior	2.31	1.32	0–5	0.16	-0.44
8. Avolition internal experience	1.97	1.42	0–5	0.22	-0.74
BNSS MAP Subscale (Average)	1.91	1.13	0–4.57	0.23	-0.45
9. Facial expression	2.46	1.51	0–6	0.09	-0.48
10. Vocal Expression	2.11	1.69	0–6	0.61	-0.34
11. Body Gestures	2.20	1.69	0–6	0.40	-0.62
12. Quantity of speech	1.18	1.59	0–6	1.40	1.19
13. Spontaneous elaboration	1.42	1.79	0–6	1.14	0.17
BNSS EXP Subscale (Average)	1.87	1.51	0–5.8	0.78	0.04
BNSS Total (Sum)	23.93	15.17	1–64	0.59	-0.09
CAINS					
1. Motivation for close family/spouse/partner relationships	1.05	0.78	0–3	0.33	0.59
2. Motivation for close friendships/romantic relationships	1.49	1.03	0–4	0.02	-0.76
3. Frequency of pleasurable social activities—past week	1.42	1.18	0–4	0.18	-1.06
4. Frequency of expected pleasurable social activities—next week	1.97	1.17	0–4	-0.48	-0.77
5. Motivation for work and school activities	2.12	1.46	0–4	-0.10	-1.38
6. Expected pleasurable work and school activities—next week	3.14	1.10	0–4	-1.51	1.96
7. Motivation for recreational activities	1.22	1.13	0–4	0.78	-0.04
8. Frequency of pleasurable recreational activities—past week	1.37	1.05	0–4	0.27	-0.44
9. Frequency of expected pleasure from recreational activities—next week	1.43	1.17	0–4	0.11	-1.25
CAINS MAP Subscale (Sum)	15.05	6.55	1–28	-0.28	-0.77
10. Facial expression	1.82	1.14	0–4	-0.08	-0.95
11. Vocal expression	1.51	1.11	0–4	0.23	-0.78
12. Expressive gestures	1.63	1.18	0–4	0.29	-0.84
13. Quantity of speech	1.08	1.18	0–4	0.62	-0.94
CAINS EXP Subscale (Sum)	5.97	4.12	0–14	0.22	-1.17
CAINS total (Sum)	21.01	9.78	1–38	-0.19	-1.13

Table 3. Correlations Between BNSS and CAINS Items

	BNSS Intensity of Pleasure	BNSS Frequency of Pleasure	BNSS Intensity of Future Pleasure
Anhedonia			
CAINS Frequency of pleasurable social activities—past week	0.20	0.39**	0.25*
CAINS Frequency of expected pleasurable social activities—next week	0.34**	0.18	0.19
CAINS Frequency of expected pleasurable work and school activities—next week	0.09	0.39**	0.26*
CAINS Frequency of pleasurable recreational activities—past week	0.27*	0.38**	0.39**
CAINS Frequency of expected pleasure from recreational activities—next week	0.16	-0.04	0.23
Avolition			
	BNSS avolition behavior	BNSS avolition internal experience	
CAINS Motivation for Work and School Activities	0.58***	0.56***	
CAINS Motivation for Recreational Activities	0.38**	0.52***	
Asociality			
	BNSS asociality behavior	BNSS asociality internal experience	
CAINS Motivation for close family/spouse/partner relationships	0.53***	0.45***	
CAINS Motivation for close friendships/romantic relationships	0.69***	0.68***	
Blunted affect			
	BNSS facial expression	BNSS vocal expression	BNSS body gestures
CAINS facial expression	0.74***	0.71***	0.71***
CAINS vocal expression	0.75***	0.76***	0.74***
CAINS expressive gestures	0.72***	0.61***	0.63***
Alogia			
	BNSS quantity of speech	BNSS spontaneous elaboration	
CAINS quantity of speech	0.63***	0.61***	

Note: * $P < .05$, ** $P < .01$, *** $P < .001$.

items were significantly correlated with the BNSS and CAINS total scores.

Factor analytic studies support a 2-factor solution for the BNSS and CAINS, with dimensions of Motivation and Pleasure (MAP) (anhedonia, avolition, asociality) and Expressivity (EXP) (blunted affect, alogia).^{7,10,11,14,15,23} As such, item-subscale total correlations were calculated. The BNSS lack of normal distress item was not included in either EXP or MAP subscale calculations because it did not load highly on either dimension in prior factor analytic studies. On the CAINS, all items in the MAP subscale were significantly correlated with MAP total score (range $r = .35$ to $.68$) and all items within the EXP subscale were significantly correlated with the EXP total score (range $r = .89$ to $.93$). Similarly, for the BNSS all items in the MAP subscale were significantly correlated with the MAP subscale total score (range $r = .74$ to $.87$) and all items within the EXP subscale were significantly correlated with the EXP subscale total score (range $r = .90$ to $.93$).

Alpha-if-item deleted coefficients ranged from $.93$ to $.95$ on the BNSS and $.88$ to $.90$ on the CAINS. Alpha-if-item-deleted analyses for the subscales were: MAP

subscale of the BNSS ($.88$ to $.92$) and CAINS ($.78$ to $.81$) and EXP subscale of the BNSS ($.93$ to $.94$) and CAINS ($.91$ to $.93$).

Convergent Validity

The BNSS and CAINS total scores were significantly correlated with the SANS total and the BPRS negative symptom factor. The MAP subscales of the BNSS and CAINS were significantly correlated with the SANS MAP dimension (SANS EXP was calculated as the average of the blunted affect and alogia items. SANS MAP was calculated as the average of the avolition and anhedonia/asociality scales). The EXP subscales of the BNSS and CAINS were significantly correlated with the SANS EXP dimension (table 4).

LOF total, social, and work function scales were significantly correlated with BNSS and CAINS MAP, EXP, and total scores (table 4).

MCCB global scores were significantly associated with BNSS EXP and BNSS total, but not BNSS MAP scores. CAINS MAP, EXP, and total scores were not significantly correlated with MCCB global scores (table 4). The

Table 4. Convergent Validity

	BNSS Total	BNSS EXP	BNSS MAP	CAINS Total	CAINS EXP	CAINS MAP
SANS Total	0.88***	0.82***	0.81***	0.79***	0.77***	0.70***
SANS EXP	0.89***	0.94***	0.71***	0.70***	0.77***	0.56***
SANS MAP	0.72***	0.56***	0.76***	0.73***	0.63***	0.70***
BPRS Negative	0.82***	0.85***	0.66***	0.63***	0.67***	0.52***
LOF Total	-0.68***	-0.56***	-0.72***	-0.67***	-0.59***	-0.63***
LOF Social	-0.65***	-0.56***	-0.67***	-0.66***	-0.59***	-0.62***
LOF Work	-0.47***	-0.37**	-0.52***	-0.46***	-0.37**	-0.46***
MCCB Total	-0.29*	-0.39**	-0.15	-0.11	-0.20	-0.03
DPB	0.38**	0.38**	0.35**	0.32*	0.35**	0.26*
Chapman PA	0.19	0.16	0.21	0.11	0.13	0.08
Chapman SA	0.32*	0.25	0.35**	0.20	0.21	0.16

Note: EXP, emotional expressivity; LOF, Level of Function Scale; SANS, Scale for the Assessment of Negative Symptoms; MCCB, MATRICS Consensus Cognitive Battery; DPB, defeatist performance Beliefs Scale; Chapman PA, Chapman Scale Physical Anhedonia; Chapman SA, Chapman Scale Social Anhedonia. MCCB $n = 62$; DPB $n = 60$; Chapman PA and SA $n = 57$.

* $P < .05$, ** $P < .01$, *** $P < .001$.

Table 5. Discriminant Validity

	BNSS Total	BNSS EXP	BNSS MAP	CAINS Total	CAINS EXP	CAINS MAP
BPRS Positive	0.15	0.05	0.25*	0.21	0.13	0.23
BPRS Disorganization	0.35*	0.18	0.42***	0.43***	0.32**	0.44***
BPRS Depression	-0.10	-0.10	-0.03	-0.02	-0.10	0.04
BPRS Total	0.59***	0.51***	0.62***	0.55***	0.47***	0.53***

Note: * $P < .05$, ** $P < .01$, *** $P < .001$.

difference in magnitude of correlations with cognition was not statistically significant.

BNSS and CAINS EXP, MAP, and total scores were significantly correlated with defeatist performance beliefs (DPB). BNSS Total and MAP were significantly correlated with social anhedonia on the Chapman scale; however, the BNSS scores were not significantly associated with Chapman scale physical anhedonia. Correlations between the CAINS and Chapman social and physical anhedonia scales were nonsignificant (table 4). The difference in magnitude of correlations was not statistically significant.

Discriminant Validity

Discriminant validity was evaluated by examining magnitude of correlations between the negative symptom scales (BNSS, CAINS) and BPRS Psychosis, Disorganization, and Depression. Both scales showed low to nonsignificant correlations with these BPRS scales. Both scales showed moderate correlations with the BPRS total score (table 5).

Discussion

The current study was the first to examine convergence between the 2 negative symptom scales developed in response to the NIMH consensus conference,¹ the CAINS³ and BNSS.² Consistent with hypotheses, the

BNSS and CAINS showed high correlations for blunted affect and alogia items. Furthermore, the EXP subscales of the BNSS and CAINS were highly correlated with first generation scales, including the EXP dimension of the SANS and the BPRS negative factor which predominantly measures EXP constructs. Thus, there is high convergence among currently available negative symptom scales with regard to measurement of the EXP domain; however, the CAINS and BNSS have conceptual advantages over the older scales in that they isolate facial affect, vocal expressivity, and body gestures. From our experience, dividing blunted affect into these 3 components helps to teach the construct and may allow raters to become reliable more quickly.

The high convergence between the CAINS and BNSS items of blunted affect is interesting. It suggests that either (1) facial, vocal, and expressive gestures highly co-occur or that (2) both measures inadequately discriminate between these distinct aspects of blunted affect. It is tempting to assume that the first possibility is correct for conceptual reasons; however, research using objective computer-based measures of blunted affect suggests that different channels of emotional expression are not highly correlated in schizophrenia.³⁶⁻⁴⁰ Additionally, there is evidence that "halo" effects influence trained clinicians when making clinical ratings of expressivity in speech.⁴¹ Clinicians may use their overall impressions to guide

ratings of speech, rather than taking a nuanced approach to parsing out individual components of speech. Much like older scales, the BNSS and CAINS may have limitations at capturing these distinct components of blunted affect.

Correlations between BNSS and CAINS MAP subscales and items comprising those subscales were lower than what was observed for EXP. The avolition and asociality items were moderately to highly correlated. However, the anhedonia items showed surprisingly low correlations (table 3). There are several potential reasons for this. First, both scales include anhedonia items measuring pleasure experienced over the past week, with a key difference being that the BNSS has items for intensity and frequency of past week pleasure while the CAINS has items for only frequency of pleasure over the past week. Correlations between the past week items on each scale were low (in the $r = \sim .2$ range), even between the frequency items of each scale which might be expected to have higher associations. Low and nonsignificant correlations between the past week frequency items may reflect differences in the domains of activity evaluated on each scale. The BNSS evaluates 4 domains of pleasurable activity (work/school, recreational, physical, and social activities), whereas the CAINS evaluates 2 domains (social and recreational activities). Additionally, the CAINS frequency items require a specific count of the number of pleasurable activities experienced over the past week for each domain, whereas the BNSS evaluates frequency more broadly, aggregating frequency of pleasurable activity across multiple domains. The CAINS method of having the patient detail their activities over each day of the past week may result in a more precise account of the number and different types of pleasurable activity than what is ascertained via the BNSS interview. Second, the CAINS does not evaluate intensity of pleasure over the past week, after earlier iterations of the CAINS eliminated such items based on psychometric considerations.¹⁵ Consistent with results presented in table 3, one might not expect the BNSS intensity of past pleasure item to have a high correlation with CAINS frequency of past pleasure items given that schizophrenia patients exhibit a dissociation between capacity for pleasure (ie, liking) and the frequency with which they seek out rewarding activities (ie, wanting).^{42–46} The low correlation may therefore affirm that the BNSS and CAINS are measuring different aspects of anhedonia in their retrospective reports. Third, the anticipatory pleasure item of the BNSS measures how intensely patients expect to experience positive emotion during future activities, while the CAINS measures how often patients expect to engage in certain pleasurable activities. Factors influencing how often patients expect to engage in activities may be very different than those influencing how intensely they expect to feel during activities they commonly engage in. Expected pleasure items on the 2 scales may

therefore be evaluating distinct aspects of anticipatory anhedonia. Overall, studies interested in anhedonia as a reduction in the frequency of anticipated or experienced pleasure might benefit from using the CAINS which covers these constructs extensively, whereas studies interested in anhedonia as an abnormality in the intensity of past or future pleasure might benefit from selecting the BNSS.

Psychometric properties of both scales were generally good, which is consistent with earlier publications on the English versions of the BNSS and CAINS.^{2,5,16,17} On both measures, internal consistency estimates using Cronbach's alpha were high, item-total correlations were moderate to high, and alpha-if-item deleted correlations were comparable between the scales. Furthermore, previous factor analytic studies of the English versions have supported a 2-factor solution for both scales,^{16–18} with factors reflecting EXP and MAP. In the current study, the MAP and EXP subscales of both measures displayed good internal consistency and good item-total-correlations, supporting subscale reliability. Good discriminant validity was evident on both scales, as indicated by marginally or nonsignificant correlations with measures of psychosis, disorganization, and depression. At first glance, results appear to suggest that the BNSS has better convergent validity with the SANS, BPRS negative factor, and LOF than does the CAINS. However, this is likely an artifact of practical constraints of the study design, which required having the rater who completed the BNSS also complete the BPRS, SANS, and LOF and another rater complete the CAINS in a separate interview. The BNSS did, however, demonstrate significant correlations with some objective measures that were not observed on the CAINS, including Chapman scale social anhedonia and global cognition on the MCCB; although the difference in magnitude of correlation between the 2 scales was not statistically significant. Recent studies have differed regarding whether they consider correlations with cognition to reflect convergent or discriminant validity.^{5,16} We consider cognitive tests to fall in the realm of convergent validity. Support for this position comes from a consistent body of evidence indicating a significant inverse correlation between neuropsychological test performance and negative symptoms,⁴⁷ as well as laboratory-based studies that directly manipulated cognitive demand (eg, increasing working memory load) and found that reducing cognitive resources parametrically increases the severity of negative symptoms.⁴⁸ Significant correlations with cognition therefore support the convergent validity of the BNSS. However, the BNSS was not significantly correlated with the Chapman physical anhedonia scale, perhaps surprisingly since the BNSS anhedonia items evaluate physical pleasure along with recreation, social, and work/school domains. This nonsignificant correlation likely reflects the procedure of having raters aggregate anhedonia ratings across multiple domains of activity, not just physical

activity. Both scales showed good convergent validity with the defeatist performance beliefs (DPB) scale; however, neither scale showed a higher correlation between DPB and MAP compared to EXP, as might be expected. Thus, results provided mixed support for convergent validity of both scales.

Certain limitations should be considered when evaluating the current results. For practical purposes (ie, time constraints and patient burden), the BNSS was administered along with the convergent/discriminant validity interview measures (SANS, BPRS, LOF), and the CAINS was administered alone. It is possible that the administration of the other scales influenced scoring of the BNSS in a way that did not occur for the CAINS, as additional information was obtained during the BNSS interview which may have provided raters with a richer set of information when making their ratings for the BNSS than CAINS. The study design may have also artificially reduced the convergence between the BNSS and CAINS—notably for the MAP scales. Both scales measure recent experiences (ie, past week). Since the BNSS and CAINS were rated by separate interviewers and completed on different days within the same week, the activities/experiences would have by default differed when measured across the 2 time points. These differences were not systematic because participants were evaluated at variable, rather than specific (eg, on Monday vs Friday) points of the week. Given that weekday and weekend experiences typically differ in hedonic tone, and because retrospective/prospective reports for these experiences likely differed randomly as a function of time between the CAINS and BNSS evaluations, the study design may have artificially introduced noise that attenuated correlations between measures. Correlations between the BNSS and CAINS are therefore likely artificially attenuated, and those among the BNSS, SANS, BPRS, and LOF are likely artificially inflated. Correlations should therefore be interpreted with these cautions in mind.

Overall, results suggest that the BNSS and CAINS are promising new negative symptom measures with good psychometric properties. There are several key differences between the scales. First, the method for developing the scales differed. The CAINS was initially developed in a pilot study¹⁵ and validated across 2 large samples that refined the CAINS beta measure,¹⁵ modifying items and deleting underperforming or redundant items based on an iterated data analysis procedure.^{3,16,17} The BNSS was developed with an initial pilot study² and then psychometrically evaluated and validated with larger samples,^{5,18} which revealed that items from the originally developed scale were psychometrically sound and not in need of modification. Second, the scales also differ in interview length (BNSS 10–15 min; CAINS 15–30 min), stability of measurement (BNSS $r = .93^4$; CAINS: $r = .69^{15}$) (Given similarities among previous psychometric studies conducted with the BNSS and CAINS [eg, rater training,

patient samples, institutions], differences in test–retest reliability are unlikely to be attributable to context, but rather the scales themselves. However, differences in the interval between testing sessions may have influenced the stability estimates found between the scales: CAINS = 14 days; BNSS = 88 days.), and specific content measured by items in the motivation and pleasure (MAP) dimension. These differences may suggest that the BNSS offers advantages for study contexts requiring quick interview administration and high test–retest reliability (eg, clinical trials), whereas the CAINS has advantages for studies that can accommodate a lengthier interview and necessitate a nuanced coverage of the range and frequency of pleasurable activities when measuring anhedonia (eg, laboratory based experimental psychopathology studies). However, both scales should be seen as appropriate for use in both clinical trials and laboratory-based studies; indeed, both are being used broadly within the field for both of these purposes.

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