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Do the Components of Attenuated Positive Symptoms Truly Represent One Construct?

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***Background and Hypotheses*: Psychosis-risk inventories, like the *Structured Interview for Psychosis-Risk Syndromes* (SIPS), utilize symptom components and coalesce the information into a single-severity rating. These components include frequency, duration, in-the-moment conviction, retrospective insight, distress, and effect on social/role functioning. While combining components distills a great deal of important information into one practical symptom rating, this approach may mask important details of the greater clinical picture. *Study Design*: Individuals at clinical high risk for psychosis (n = 115) were assessed with the SIPS Score Separable Components (SSSC) scale, created to accompany the SIPS positive items by dividing each item into the 7 components identified above. The latent structure of the SSSC was identified with an exploratory factor analysis (EFA). The factors were followed up with validation analyses including hypothesized cognitive, functioning, and symptom measures. Finally, clinical utility analyses were conducted to understand relationships between psychosis risk and common comorbidities. *Study Results*: EFA revealed that the SSSC had 3 interpretable factors with the appropriate fit (rmsr = 0.018, TLI = 0.921): *Conviction* (in-the-moment conviction, retrospective insight), *Distress-Impairment* (distress, social/role functioning), and *Frequency/Duration* (frequency, duration). *Conviction* was minimally valid, *Distress-Impairment* had excellent validity, and *Frequency/Duration* was not related to any of the candidate validators. *Conviction* significantly predicted elevated psychosis risk. *Distress-Impairment* was related to common comorbid symptoms. Notably, the factors associated more strongly with clinical features than the traditional SIPS scores. *Conclusions*: The SSSC offers a supplemental approach to single-severity ratings, providing useful clinical insight, mechanistic understanding, and the potential for better capturing heterogeneity in this population.**

Key words: clinical high risk for psychosis/symptom dimensions/factor analysis/conviction/distress/functional impairment/frequency/duration

Introduction

In individuals diagnosed with schizophrenia spectrum disorders, there is increasing attention to the multidimensional nature of the severity of psychotic symptoms, including how distressing a symptom is or how frequently it occurs.[1] However, this multidimensional view is often overlooked in assessment of the clinical high risk (CHR) for the psychosis period, as many components of symptom severity (frequency, duration, conviction, distress, and effect on functioning) are simultaneously considered when rating attenuated positive symptoms. While this single-rating approach provides an important scaffolding that popular structured diagnostic interviews (eg, *Structured Interview for Psychosis-Risk Syndromes;* SIPS[2]) use to produce reliable ratings and categorizations, it may neglect meaningful information important to the clinical picture. Therefore, understanding these components separately might impart significant utility for understanding the mechanisms of attenuated positive symptoms and informing treatment.

Conviction, or how much one believes a symptom is real, is an important symptom component, with full conviction often marking the conversion from an attenuated positive symptom to a full psychotic symptom. However, delusional beliefs are often not held with full—or even high—conviction in people with psychosis,[3,4] indicating that some individuals may be missed by a system that

prioritizes conviction as a determiner of severity and not receives needed care. Nevertheless, conviction is related to belief inflexibility,[5] jumping to conclusions,[6,7] anxiety,[5,7] and more, and remains an important construct. Conviction is a facet of clinical insight, or one's understanding of their illness and its effects.[8] In psychosis, there is a moderate negative relationship between positive symptoms and clinical insight, with insight explaining 10%–22% of the variance of positive symptoms.[8–11] Therefore, while notable, level of insight does not solely determine positive symptom severity. This relationship is further complicated as those with higher clinical insight are more likely to adhere to treatment,[8,12,13] but insight tends to not change with the use of antipsychotic medications.[14]

The Diagnostic and Statistical Manual of Mental Disorders-Fifth Edition (DSM-5)[15] places significant emphasis on symptom distress and/or impairment, including in its consideration of Attenuated Psychosis Syndrome (a diagnostic construct aligned with the SIPS). Symptom distress may be critically important to understanding severity, as fully-formed positive symptoms can be minimally distressing while lesser-formed symptoms can cause substantial distress.[16] In college students, the presence of frequent attenuated positive symptoms did not predict help-seeking behavior, but help-seeking individuals reported double the amount of symptom distress.[17] Distress and preoccupation also better distinguish people with schizophrenia from controls than other symptoms components.[3,4] Severity ratings may further be altered by symptom effect on social and role functioning. Social functioning is one's interpersonal interactions and activities and role functioning is one's ability to perform work, school, or chore activities.[18] Those experiencing attenuated positive symptoms tend to have lower levels of functioning, in particular social functioning.[19] The North American Prodrome Longitudinal Study even uncovered that a decline in social functioning is a crucial predictor of conversion to psychosis.[20]

Frequency and duration, other positive symptom severity components, are commonly used as a proxy for severity. In studies examining the relationship between positive symptom rating scales and the 11 hallucination components of the Psychotic Symptom Rating Scales (PSYRATS), hallucination ratings largely only related to frequency and duration, and to a lesser extent disruption and beliefs about the origin.[21,22] This makes sense as individuals experiencing increasing attenuated positive symptom frequency over time are more likely to convert to psychosis than those with persistent low-frequency symptoms.[23] However, as shown above, this is hardly the only symptom domain that imparts real-world impact. There is no research on the effects of the duration of a symptom but, hearing one's name called out for a brief second likely has different effects than a continuous voice or dialogue. While frequency, duration, conviction, distress, and functioning all contribute to symptom severity, some may exist on orthogonal constructs that offer unique information about mechanisms, treatment targets, and risk of developing psychosis.

As noted, the SIPS combines these components into a single-severity rating. For example, when considering a score for *Unusual Thinking*, a SIPS positive symptom domain, assessors are asked to consider the frequency, duration, conviction, distress, and impairment associated with an experience, and then match these details to descriptions/anchors on a Likert scale that provides a single score. An experience that is puzzling is viewed as less severe than one that is distressing, those that are impairing/affect behavior are scored higher still, and those accompanied by limited insight are reserved for the more severe ratings—which are all conflated on the same scale. This method is extremely valuable, as the detailed anchors allow for high reliability and lend validity by encapsulating rich clinical experiences. Single ratings also distill the abundance of information collected by the interview into diagnoses that have been useful for detection and treatment applications[24] and show substantial predictive validity.[25] However, there is much that we do not yet understand about the mechanisms of attenuated positive symptoms and how that impacts treatment, quality of life, and vulnerability of converting to psychosis. Therefore, it is crucial to understand how these constructs may align into different symptom dimensions. The Comprehensive Assessment of At-Risk Mental States (CAARMS)[26] assesses frequency and distress separate from severity, which has been remarkably useful and implores the question of separating these components further. While there has been examination of separate symptom components in psychotic disorders,[1,27] to the best of our knowledge, this work has not been fully explored in CHR populations.

Due to the need for understanding the components of attenuated positive symptoms, we designed a novel measure to pair with SIPS positive ratings, called the SIPS Score Separable Components (SSSC) scale. Using the SSSC, we examined 3 aims. First, we aimed to explore whether the facets of positive symptoms evaluated on the SSSC could be empirically split into factors that reflect different symptom dimensions vs whether they are completely independent constructs or better described on 1 dimension. We hypothesized that SSSC items would separate into interpretable factors that can provide meaningful information about attenuated positive symptomatology. Second, we aimed to establish the validity of the factors. We hypothesized that these factors would demonstrate associations with existing measures intended to measure similar constructs or ones that have been previously found to be related (eg, global functioning, working memory, and quality of life). Third, we aimed to explore the clinical utility of the factors. We assessed whether these factors are sensitive to psychosis-risk measurements (eg, conversion

Table 1. Demographics

n = 115		Mean	SD
Age		20.57	2.42
WASI IQ		111.54	13.68
		N	%
Sex	Female	84	73
	Male	31	27
Race	White	70	62.5
	Black	18	16.1
	Asian	17	15.2
	More than one race	7	6.3
Ethnicity	Hispanic	10	8.7
	Non-Hispanic	105	91.3
Household income	$0–9 999	20	20.2
	$10 000–19 999	4	4.0
	$20 000–34 999	8	8.1
	$35 000–49 999	10	10.1
	$50 000–69 999	16	16.2
	$70 000–99 999	15	15.2
	$100 000 and over	26	26.3
Parental education	Less than a high school degree	8	7.1
	High school degree or equivalent	10	8.9%
	Some college	17	15.2
	Associates degree	18	16.1
	Bachelor's degree	44	39.3
	Graduate degree	6	5.4
Medication	Antipsychotic	4	3.5

risk, syndrome status, negative symptoms, and self-reported attenuated positive symptoms). To further this aim, we hypothesized that these factors would provide meaningful information above and beyond what is measured with the traditional SIPS Positive-item ratings. Additionally, we assessed whether certain demographics are more likely to experience one kind of symptom severity over another and whether these factors are related to commonly co-occurring clinical symptoms (eg, psychosocial stress, depression, and anxiety).

Methods

Participants

Participants were aged 16–30 years and recruited as part of the Multisite Assessment of Psychosis-risk study,[28] which aims to identify markers of psychosis-risk in a large representative community sample recruited across 4 sites–Temple University, University of Maryland-Baltimore County, University of California, Irvine, and Northwestern University. See supplement for recruitment and study details (full procedures described elsewhere[28]). 823 participants consented to the baseline assessment consisting of clinical assessments and a cognitive battery. A total of 141 participants were identified as CHR, 115 of which had SSSC data and thus used in these analyses (demographics in table 1, clinical measure distribution in supplementary table S2).

Measures

Structured Interview for Psychosis-Risk Syndromes: The SIPS version 5.6.[2] assesses for 5 positive (P) symptoms (unusual thought content/delusional ideas, suspiciousness/persecutory ideas, grandiose ideas, perceptual abnormalities/hallucinations, disorganized communication) rated on a 0–6 scale, with ratings of 3–5 being in the clinical, but not psychotic, range. Participants were given a CHR diagnosis if they met for Attenuated Positive Symptom Syndrome (APSS), Brief Intermittent Psychotic Syndrome (BIPS), or Genetic Risk and Deterioration Syndrome, as designated by the SIPS.

SIPS Score Separable Components (SSSC) scale: The SSSC (supplementary table S1) is a novel scoresheet for the SIPS positive symptom items that break down the single rating per symptom into the separate components used to make that rating without adding additional administration time. These components include frequency, duration, conviction in the moment (belief in the symptom while it is occurring), retrospective insight (understanding an experience is a symptom while it is not occurring), distress, effect on social functioning, and effect on role functioning. Each of these 7 components is rated on a 0 (not symptomatic/absent) to 6 (very

symptomatic) scale for each of the 5 positive symptoms that are assessed. Every component has an individual anchor description to rate and interpret effectively. Assessors were specifically instructed to rate these 7 components independent of the SIPS rating for the item and that SSSC ratings did not have the same interpretation as the SIPS. In this study, the primary measures for the SSSC were the averages for each of the 7 components across any SIPS P-items rated 1 or higher, so as not to be skewed by symptoms that were not present within an individual (see supplemental methods).

Additional measures are summarized in table 2 and detailed in the supplement.

Statistical Analyses

Factor Structure. For aim 1, an exploratory factor analysis (EFA) of the 7 SSSC components was performed. The correlation matrix of these items was visually inspected to determine the factorability of the data, with an examination of the determinant. Furthermore, a Kaiser–Meyer–Olkin test and Bartlett's Test of Sphericity were completed to assure EFA was appropriate for these data. To determine the appropriate number of factors indicated, a parallel analysis was performed, and the scree plot of eigenvalues was examined (see supplementary methods). Maximum likelihood was chosen as the factoring method because of the balance of fit statistics and complexity of the items across factors. Oblimin rotation was chosen as it allowed for the most robust separation between the factors. The EFA was constricted to the number of factors indicated in the parallel analysis. Factor scores were extracted for further analysis.

Validation Analyses. After factoring the items, we hypothesized which clinical, cognitive, and functioning variables should be related to each factor given our interpretation of each of the constructs. A series of multiple regressions were conducted with all factors as predictors in every model and the external validators as the dependent variable in separate models. When response variables were categorical, logistic regressions were run instead. Initially, the models allowed factor scores to interact, but as there was no a priori hypothesis about interactions, models were reduced when interactions were not present. All main effects always remained in the models.

Clinical Utility. To examine the extent that these factors relate to other psychosis-risk variables, multiple regressions, identical in structure to the validation analyses, were run with the SHARP SIPS-risk calculator scores (measures vulnerability of converting to psychosis),[29] negative symptoms (PINS),[30] and self-reported attenuated positive symptoms (PRIME screen).[31] A multivariate regression with APSS status predicting the factors was also done for the same reason. To ascertain whether the factors provide additional information than the traditional P-item ratings, multiple regressions were conducted using the average P-item rating for all symptoms rated 1 or higher, with the same dependent variables as the validation analyses. The relationship between demographic variables (age, sex, parental education, and household income) with the factor scores was assessed using multivariate regressions and other commonly co-occurring psychopathology (anxiety,[32,33] depression,[34,35] social phobia,[36] and perceived stress[37]) with the factors using multiple regressions (presented in supplementary material).

Results

Factor Structure

To assess whether the SSSC can be empirically split into interpretable factors, an EFA was conducted. The Kaiser–Meyer–Olkin test (overall MSA = 0.67) and Bartlett's Test of Sphericity ($\chi^2(21) = 373.5$, $p = 2.8e\text{-}66$) both suggested that factoring is appropriate and the correlation matrix (supplementary figure S1) had a positive determinant (0.034). Parallel analysis and the scree plot suggested 3 factors for the SSSC data (supplementary figure S2).

We identified 3 interpretable factors with the appropriate fit (figure 1; rmsr = 0.018, TLI = 0.921): *Conviction*, *Distress-Impairment*, and *Frequency/Duration*. The *Conviction* factor consists of conviction in the moment (loading = 0.78) and retrospective insight (loading = 1.03). The *Distress-Impairment* factor consists of self-reported distress (loading = 0.51), effect on social functioning (loading = 0.86), and effect on role functioning (loading = 0.77). The *Frequency/Duration* factor consists of symptom frequency (loading = 0.54) and symptom duration (loading = 0.96). This model explains 67% of the variance of the items, which breaks down to 25% variance explained by *Conviction*, 24% by *Distress-Impairment*, and 18% by *Frequency/Duration*. *Conviction* and *Distress-Impairment* correlated $r = .42$, *Conviction* and *Frequency/Duration* $r = .47$, and *Distress-Impairment* and *Frequency/Duration* $r = .29$.

Factor Validation

See figure 2 for summarized regression results.

Conviction. Given the relationship between insight and various cognitive measures in the literature, we hypothesized that the *Conviction* factor would relate to general intelligence,[38] working memory,[39] and executive functioning.[38,40] d' for the 0-Back (sustained attention) condition of the N-Back (working memory)[41] was inversely predicted by the interaction of *Conviction* and *Distress-Impairment* ($b = -0.141$, $t(100) = -4.270$, $p = 4.45e\text{-}05$, $f^2 = 0.182$; figure 3A, supplementary table S3). However, d' for 1-Back and 2-Back (higher working memory loads)

Table 2. Summary of Relevant Study Measures

Domain	Measure	Description	Citation
Attenuated positive symptom rating	Structured Interview for Psychosis-Risk Syndromes, Positive Items (SIPS P-items)	Semi-structured interview that assesses the severity of 5 positive symptoms aimed to capture clinical high-risk for psychosis syndromes.	Miller et al. (2003)[2]
	SIPS Score Separable Components (SSSC)	A novel measure breaking down the 5 SIPS positive symptom ratings into 7 separable symptom components.	
	Prevention through Risk Identification, Management, and Education (PRIME) Screen	12-item self-report measures assessing attenuated positive symptoms on 2 scales: severity and distress.	Miller et al. (2004)[31]
General intelligence	Wechsler Abbreviated Scale of Intelligence-Second Edition (WASI-II) 2 Subtest IQ	An assessment of vocabulary and matrix reasoning abilities to approximate IQ.	Wechsler (2011)[42]
Working memory	Penn Letter N-Back d'	A measure of signal detection for working memory of letters for 3 memory loads: 0-back (stagnant target to press when shown), 1-back (press button when the same letter was shown immediately previous), and 2-back (press button when the same letter was shown 2 previous).	Ragland et al. (2002)[41]
Executive functioning	Penn Conditional Exclusion Test (PCET)	Abstraction and mental flexibility test where participants have to determine which object does not belong in a group of objects.	Kurtz et al. (2004)[43]
	Penn Verbal Reasoning Test (PVRT)	Language reasoning test where participants answer verbal analogy problems.	Gur et al. (2010)[44]
Global functioning	Global Assessment of Functioning (GAF)	Rating of 0–100 of how well a participant is functioning in general, combining social and role functioning. Rated on current and from 1 year ago.	Hall (1995)[45]
Social functioning	Social Functioning Scale (SFS)	79-item self-report measure to assess social engagement, interpersonal contact, recreation, and independence/competence in activities of daily living and employment.	Birchwood et al. (1990)[46]
Treatment utilization	Treatment Health Questionnaire (TRHQ)	Assessment of past and current experiences with mental health services including therapy, medications, diagnoses, and hospitalizations.	
Quality of life	Quality of Life Enjoyment and Satisfaction Questionnaire – Short Form (QLES-SF)	Assessment of enjoyment and satisfaction with several areas of daily functioning within the past week.	Endicott et al. (1993)[51]
Attention	Penn Continuous Performance Test (PCPT)- Number Letter version	Test of sustained attention and vigilance independent of working memory or perceptual factors where participant presses the button when lines are configured as complete numbers or letters.	Kurtz et al. (2001)[52]
Psychosis conversion risk	SHARP groups SIPS-Risk Calculator (SHARP-RC)	An estimate of an individual's vulnerability of converting to psychosis based on their GAF change over a year and 7 items from the SIPS.	Zhang et al. (2019)[29]
Negative symptoms	Prodromal Inventory of Negative Symptoms (PINS)	Semi-structured interview that assesses the presentation of negative symptoms in the psychosis-risk population.	Pelletier-Baldelli et al. (2017)[30]
Depression	Center for Epidemiological Studies, Depression Scale (CES–D)	14-item self-report measure that assesses the severity of depressive symptoms in the past week.	Kohout et al. (1993)[34]
Anxiety	State-Trait Anxiety Inventory (STAI) Trait Version, Anxiety subscale	Self-report measure of generalized anxiety, excluding those that relate heavily with depression.	Spielberger (2010)[32], Bieling et al., (1998)[33]
Social phobia	Social Phobia Scale (SPS)	20-item self-report measure that assesses anxiety caused by fear of scrutiny from and being observed by others.	Mattick and Clarke (1998)[36]
Perceived stress	Perceived Stress Scale (PSS)	Self-report measure of perceived global stress and coping ability that focuses on how an individual perceived the predictability and controllability of events in the past month.	Cohen et al. (1983)[37]

	Conviction	Distress-Impairment	Frequency/ Duration	h2	u2	com	Conviction||Distress-Impairment||Frequency/Duration
Frequency	0.001	0.021	**0.542**	0.301	0.699	1.003	0.54
Duration	0.028	-0.005	**0.963**	0.950	0.050	1.002	0.96
Conviction	**0.781**	0.158	0.099	0.829	0.171	1.115	0.78 0.16 0.10
Insight	**1.027**	-0.058	-0.015	0.995	0.005	1.007	1.03
Distress	0.028	**0.512**	-0.015	0.270	0.730	1.008	0.51
Social Functioning	-0.068	**0.855**	0.105	0.743	0.257	1.043	0.86 0.10
Role Functioning	0.123	**0.765**	-0.132	0.624	0.376	1.113	0.12 0.76

Fig. 1. SIPS Score Separable Components (SSSC) exploratory factor analysis (EFA) loadings. *Note*: h2 = Communality; u2 = Uniqueness; com = Complexity. Bar charts represent factor loadings.

	Conviction Hypothesis						Distress-Impairment Hypothesis						Frequency/ Duration Hypothesis	
	WASI IQ	**0-back d'**	**1-back d'**	**2-back d'**	**Exec Func (PCET)**	**Exec Func (PVRT)**	**GAF Current**	**GAF 1 year ago**	**PRIME Distress**	**Social Func (SFS)**	**Current Tx Utilization**	**Past Tx Utilization**	**QOL (QLES-SF)**	**Attention (PCPT)**
Conviction	*b* = 0.64 *t* = 0.42	*b* = 0.01 *t* = 0.15	*b* = -0.07 *t* = -1.35	*b* = -0.13 *t* = -1.65	*b* = 0.09 *t* = 0.97	*b* = 2.25 *t* = 1.18	*b* = 0.68 *t* = 0.50	*b* = 1.09 *t* = 0.51	*b* = -1.11 *t* = 0.52	*b* = 0.34 *t* = 0.14	*b* = -0.13 *z* = -0.55	*b* = -0.51 *z* = -1.99	*b* = 2.42 *t* = 1.33	*b* = -0.08 *t* = -0.83
Distress-Impairment	*b* = -1.90 *t* = -1.21	*b* = -0.02 *t* = -0.557	*b* = -0.06 *t* = -1.17	*b* = -0.08 *t* = -1.02	*b* = -0.17 *t* = -1.85	*b* = -2.46 *t* = -1.31	*b* = -6.00 *t* = - 4.52	*b* = -6.45 *t* = -4.00	*b* = 6.31 *t* = 3.57	*b* = -2.48 *t* = -0.97	*b* = 0.39 *z* = 1.64	*b* = 0.57 *z* = 2.10	*b* = -2.06 *t* = -1.09	*b* = 0.03 *t* = 0.28
Frequency/ Duration	*b* = 3.19 *t* = 2.13	*b* = -0.01 *t* = -0.27	*b* = 0.06 *t* = 1.21	*b* = 0.09 *t* = 1.14	*b* = 0.10 *t* = 1.06	*b* = -0.36 *t* = -0.19	*b* = 0.06 *t* = 0.05	*b* = -0.41 *t* = -0.27	*b* = -1.41 *t* = -0.85	*b* = 2.17 *t* = 0.83	*b* = -0.14 *z* = -0.62	*b* = 0.07 *z* = 0.30	*b* = 0.57 *t* = 0.33	*b* = 0.05 *t* = 0.54
Conv x Dist-Im	--	*b* = -0.14 *t* = -4.27	--	--	--	--	--	--	--	--	--	--	--	--
P-item mean	*b* = 3.67 *t* = 1.68	*b* = -0.04 *t* = -0.77	*b* = -0.09 *t* = -1.19	*b* = -0.09 *t* = -0.84	*b* = -0.01 *t* = -0.11	*b* = 1.46 *t* = 0.55	*b* = -6.02 *t* = -3.10	*b* = -8.47 *t* = -3.72	*b* = 7.18 *t* = 2.96	*b* = -3.27 *t* = -0.95	*b* = 0.71 *z* = 2.12	*b* = 0.22 *z* = 0.65	*b* = -0.50 *t* = -0.21	*b* = -0.11 *t* = -0.82
Significance:		Positive P < 0.0001	Positive P < 0.001	Positive P < 0.01	Positive P < 0.05	NS	Negative P < 0.05	Negative P < 0.01	Negative P < 0.001	Negative P < 0.0001				

Fig. 2. Summarized regression results for the validity analyses and P-item comparison. Func = functioning, Tx = treatment, Sx = symptoms.

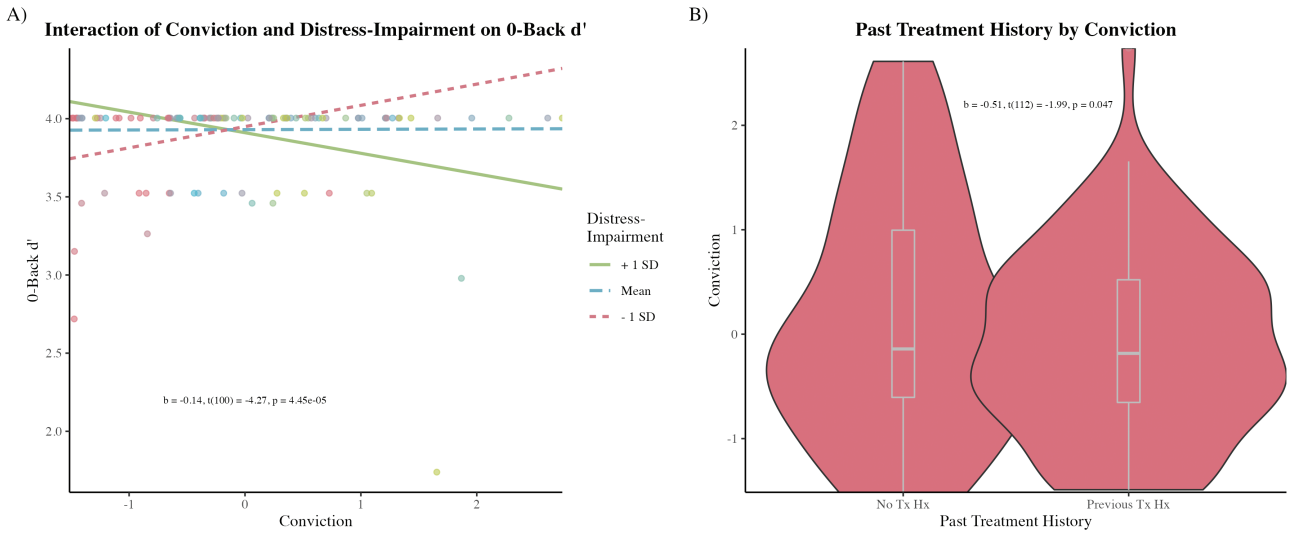

Fig. 3. (A) Interaction between the *Conviction* and *Distress-Impairment* factors on d' for the 0-back N-Back condition. High conviction affects individuals more when they also have distress and functional impairment. (B) Distribution of *Conviction* with past treatment history.

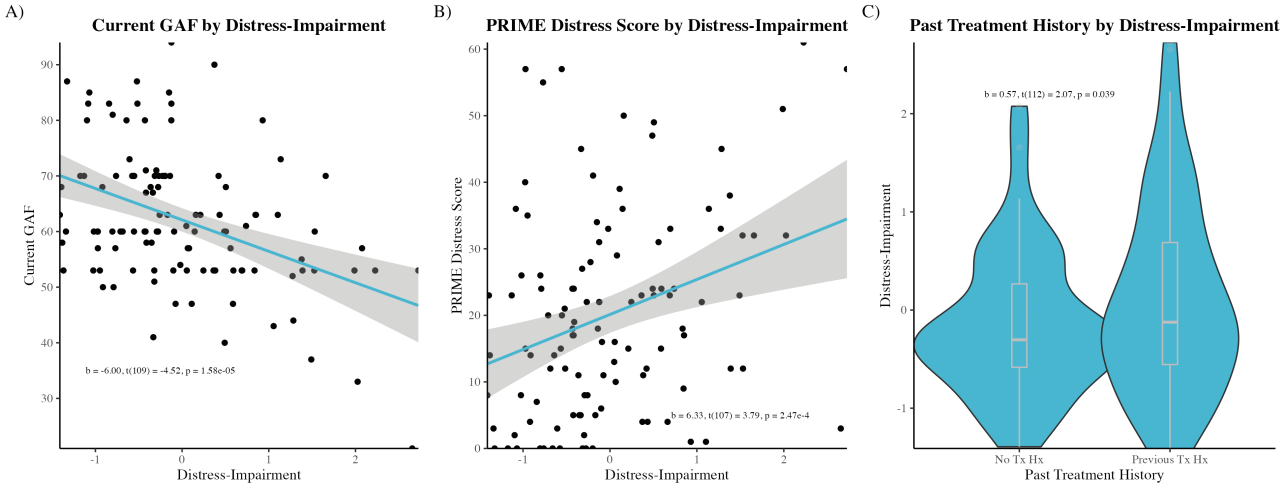

Fig. 4. (A) Relationship between *Distress-Impairment* factor and current global assessment of functioning. (B) Relationship between *Distress-Impairment* and subjective symptom distress. (C) Distribution of *Distress-Impairment* with past treatment history.

did not show the same interaction (supplementary tables S4–S5), which was unexpected given that deficits tend to be exaggerated with increased memory loads. *Conviction* did not predict IQ (WASI-II[42] 2-subtest; supplementary table S6) or executive functioning (PCET[43] or PVRT[44]; supplementary tables S7–S8). Unexpectedly, *Conviction* scores negatively predicted past treatment utilization (b = −0.514, $z(112)$ = −1.987, P = .047, OR = 0.598; figure 3B, supplementary table S12).

Distress-Impairment. Given that the *Distress-Impairment* factor items are intended to capture subjective distress and the effect symptoms have on social and role functioning, we hypothesized that it would be related to the current Global Assessment of Functioning (GAF),[45] GAF from 1 year ago, subjective distress (PRIME screen),[31] social functioning (SFS),[46,47] and treatment utilization history. As hypothesized (figure 4), the *Distress-Impairment* factor negatively predicted current GAF (b = −5.998, $t(109)$ = −4.520, p = 1.58e-05, f^2 = 0.187; supplementary table S9) and GAF from 1 year ago (b = −6.453, $t(109)$ = −4.001, p = 1.15e-04, f^2 = 0.147; supplementary table S10), while positively predicting distress (b = 6.326, $t(107)$ = 3.793, p = 2.473e-4, f^2 = 0.119; supplementary table S11) and past treatment utilization (b = 0.570, $z(112)$ = 2.066, P = .039, OR = 1.768; supplementary table S12). *Distress-Impairment* did not predict current treatment utilization (supplementary table S13) or social functioning (supplementary table S14).

Frequency/Duration. We hypothesized that the *Frequency/Duration* factor would relate to common correlates of general severity in the literature, such as quality of life[48,49] and attention.[50] However, the *Frequency/Duration* factor did not predict quality of life (QLES-SF[51]; supplementary table S15) nor attention (PCPT[52]; supplementary table S16). Unexpectedly, *Frequency/Duration* scores did positively predict IQ (b = 3.193, $t(107)$ = 2.131, P = .035, f^2 = 0.042; supplementary table S6).

Clinical Utility

Psychosis Risk Correlates. To better understand how these factors capture psychosis risk, the relationships with other psychosis-risk measures were assessed. Relating the SHARP SIPS-risk calculator scores to the factors could provide information about which symptom components lead to higher psychosis vulnerability. The SIPS-risk calculator score was positively predicted by *Conviction* scores (b = 0.522, $t(104)$ = 2.192, P = .031, f^2 = 0.046; supplementary table S17, supplementary figure S3A). Individuals who are in APSS full remission had less *Conviction* than those in APSS progression (b = −1.523, $t(110)$ = −3.012, P = .003, f^2 = 0.083; supplementary table S18), though this sample only had 4 individuals in full remission. Negative symptoms were positively predicted by *Distress-Impairment* (b = 6.491, $t(107)$ = 5.756, p = 8.3e-8, f^2 = 0.310) and negatively predicted by *Conviction* (b = −2.331, $t(107)$ = −2.078, P = .040, f^2 = 0.040; supplementary table S19, supplementary figure S3B–C). The *Distress-Impairment* factor positively predicted self-reported attenuated positive symptoms (b = 0.590, $t(111)$ = 2.289, P = .024, f^2 = 0.095; supplementary table S20).

Comparison to P-Item Ratings. To determine if individual components provide the information above and beyond what is captured in the original SIPS, the relationships between the average *P*-item score and the validators above were assessed. To a lesser extent than the *Distress-Impairment* factor, P-items also negatively predicted current GAF (b = −6.023, $t(111)$ = −3.098, P = .002, f^2 = 0.086) and GAF from 1 year ago (b = −8.474, $t(111)$ = −3.720, p = 3.15e-04, f^2 = 0.125) and positively predicted distress (b = 7.180, $t(109)$ = 2.963, P = .004, f^2 = 0.081).

The *P*-score did not predict past treatment utilization, but did predict current treatment utilization ($b = 0.710$, $z(114) = 2.123$, $P = .034$, $OR = 2.03$). The P-score did not predict any of the validators for *Conviction* or *Frequency/Duration*.

Discussion

To the best of our knowledge, this is the first investigation to examine whether individual component ratings of attenuated positive symptoms could be split into meaningful, data-driven factors and if those factors have important implications for other clinical, cognitive, and functioning areas. Results suggest there is significant value in splitting traditionally amalgamated scores into separable components: frequency, duration, conviction, insight, distress, social functioning, and role functioning. EFA revealed 3 intuitive factors: *Conviction*, *Distress-Impairment*, and *Frequency/Duration.* Notably, the *Distress-Impairment* factor had excellent convergent validity, the *Conviction* factor had minimal relations to hypothesized scales, and the *Frequency/Duration* factor could not be validated with available study measures. In addition, there is good evidence to suggest that the *Conviction* and *Distress-Impairment* factors can be clinically useful for understanding mechanisms and predicting the course of illness.

The congregation of components into *Conviction*, *Distress-Impairment*, and *Frequency/Duration* factors is similar to what has been identified in chronic schizophrenia using structural equation modeling with the PSYRATS, where Distress, Frequency, Attribution, and Loudness dimensions were found for auditory hallucinations and Distress and Frequency (which included preoccupation, conviction, and disruption) dimensions for delusions were revealed.[27] Prior to our work, the severity of separate positive symptom components had not been fully examined in CHR individuals. These findings suggest that attenuated positive symptoms have similar components to psychotic positive symptoms, and highlight that there is important information gathered in the SIPS that can be harnessed to better understand the mechanisms of—and potential treatment targets for—attenuated positive symptoms.

Efforts to validate the factors produced mixed results. The *Conviction* factor did not relate to cognitive measures as predicted, aside from interaction with *Distress-Impairment* predicting signal detection in a working memory task. Those with higher *Conviction* had a greater signal detection deficit as *Distress-Functioning* increased, but those with lower *Conviction* improved in signal detection as *Distress-Functioning* increased. This may be due to conviction being a facet of insight, where having higher insight into one's abilities results in more effort being allotted to the task at hand. Since this signal detection finding goes away as the working memory load increases, there may be a limit to this potential effort boost. The *Conviction* factor also predicted past treatment utilization, which was not hypothesized a priori, but suggests that those with better insight were more likely to have received treatment in the past. This finding aligns with previous research which identified that having good insight increases medication and therapy engagement and adherence.[8] The *Distress-Impairment* factor had excellent validity, as it related to current GAF, GAF from 1 year ago, reported distress, and past treatment utilization, which are all intended to measure different aspects of distress and functioning. Surprisingly, this factor did not relate to current treatment utilization or social functioning. *Distress-Impairment* may not relate to social functioning as the SSSC only measures social functioning related to attenuated positive symptoms, whereas the social functioning deficits found in the SFS may be due to other sources. We were unable to validate the *Frequency/Duration* factor with quality of life or attention measures. However, the inability to validate this factor does not mean that it is invalid, as the study did not include scales that were specifically meant to relate to this construct.

There were several indications that the new factors have clinical utility. Notably, the *Conviction* factor predicted individuals' psychosis-risk calculator score; while this does not mean that *Conviction* can predict conversion to psychosis, this finding does indicate that it may be sensitive to an individual's vulnerability to convert and should be investigated further. While conviction was considered in the P-ratings used to calculate the SHARP-risk score, it stood out as sensitive to psychosis vulnerability over the other 2 factors, which were also a consideration in the P-rating. Also interesting is that *Conviction* was lower in individuals in APSS full remission. Though the fully remitted sample was small ($n = 4$) and should be interpreted carefully, remission from attenuated positive symptoms might be primarily driven by finding alternative explanations for odd beliefs and experiences. Although this study is not designed to compare different at-risk syndromes on aspects such as conversion, the literature suggests that BIPS (brief but severe psychotic symptoms) has a higher prediction of conversion profile compared to other CHR syndromes[53]; this difference may be better understood by evaluating symptoms in the framework of these factors and can be examined in futures studies designed to examine conversion across syndromes.

Both the *Conviction* and *Distress-Impairment* factors predicted negative symptom ratings; individuals with more *Distress-Impairment* experienced increased negative symptoms, while those with lower *Conviction* had increased negative symptoms. The finding of higher conviction (and thus poor insight) predicting less negative symptoms is inconsistent with reports in the psychosis literature.[54–60] This may indicate that our negative symptom measure, the PINS, was sensitive to secondary negative symptoms. One study found that the relationship of

poor insight to high negative symptoms remained true for secondary negative symptoms, but their definition of secondary symptoms included everyone with "clinically relevant" positive, depressive, or extrapyramidal symptoms and may have inadvertently included individuals with co-occurring primary negative symptoms.[61] An updated version of the PINS, the Negative Symptom Inventory-Psychosis Risk, has since been published which took isolating primary negative symptoms into careful consideration.[62]

It is noteworthy that the factors demonstrated stronger associations with clinical validators than the traditional amalgamated positive symptom severity score. The mean P-rating did predict GAF and distress—though less strongly than the *Distress-Impairment* factor—and does not predict past treatment, 0-back d', or IQ. Therefore, separating ratings into orthogonal dimensions appears to highlight important relationships and inform our understanding of the mechanisms of attenuated positive symptoms. However, the *P*-average predicted current treatment utilization, which could indicate that the combined scores provide insight into one's current subjective experience. As reported in the supplement, *Distress-Impairment* predicted trait anxiety, social phobias, perceived stress, and depression, indicating that the more distressing and impairing a person's attenuated positive symptom are, the more likely they are to experience comorbid symptoms and psychosocial stressors. This may reflect that distress and impairment can blend across diagnostic boundaries, but can also be interpreted as an absence of divergent validity. Clinical utility results for the *Conviction* and *Frequency/Duration* factors should be interpreted with caution until they can be further validated.

The SIPS is an important tool for identifying and understanding attenuated positive symptoms but supplementing the single-score-based tradition with the SSSC allows for a more complete clinical picture with the potential to improve prediction, treatment, and mechanistic understanding. Although we have a well-powered sample, a larger sample including individuals who converted to psychosis would provide information about whether these factors are stable and meaningful. An additional limitation is that we do not currently have information on the inter-rater reliability of the SSSC. Furthermore, since the SIPS already accounts for the SSSC components, we could not look directly into the relationships of the factors with the SIPS P-items. This connection between the SIPS and SSSC does, however, allow for easy implementation of this scale in the future, which we recommend doing. The SSSC could also be adapted for use alongside a new measure called the Positive Symptoms and Diagnostic Criteria for the CAARMS Harmonized with the SIPS (PSYCHS). This measure emphasizes conviction and intensity, de-emphasizes distress and impairment, and separates frequency, making the SSSC a well-suited compliment. Future studies should add additional measures of convergent and discriminant validity. Evaluating the SSSC in a sample of specific mental health help-seeking individuals could further validate efforts across varying populations. Future studies should also assess whether there is utility in adding SSSC items to measure how preoccupying and fully formed/intense symptoms are to assess whether they will also aid our understanding of attenuated positive symptoms.

Supplementary Material

Supplementary material is available at https://academic.oup.com/schizophreniabulletin/.

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