Measurement Issues: The Psychometrics of Psychosis- Assessing and rating perceptual and ideational disturbance in adolescents

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**Background and Scope:** The early recognition and management of psychosis-spectrum disorders is associated with superior outcomes in affected individuals. However, this can be challenging for numerous reasons. This article provides perspectives on the effective evaluation and rating of potentially psychotic phenomena young people. We compare and contrast two widely used instruments that can support this process. **Findings:** The Comprehensive Assessment for At-Risk Mental States (CAARMS) is used to explore potentially psychotic experiences in young people perceived to be at-risk of an emerging or imminent psychosis. There is evidence to support its reliability and, to some extent, the predictive validity of the resultant scores. However, relatively low short-medium transition rates to psychosis in ‘positive’ cases suggest that its use as a screening instrument should be restricted to groups who show some indication of impending risk (e.g. help-seeking, distress, declining functioning, perceptual disturbance etc). In contrast, the Positive and Negative Syndrome Scale (PANSS) is calibrated to rate symptoms in those with an established psychosis, especially those with a diagnosis related to the schizophrenia-spectrum. Consequently the PANSS is useful for evaluating the clinical course and outcomes of psychotic illness. **Conclusions:** Although neither instrument is designed specifically for use in those under 18, with care they can be used to effectively support the management of adolescents reporting perceptual and ideational disturbance. However, it is important that any instrument ratings are placed meaningfully in the context of the overall clinical picture and all available information.

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| **Key Practitioner Message:**   * Semi-structured schedules can support the evaluation of young people who present with potentially psychotic symptoms * The CAARMS has been designed to evaluate ideational and perceptual disturbance in young people (14 to 30 year olds) who may be at imminent risk of psychosis * Emerging evidence suggests that adolescents who are categorised as being in an ‘ultra-high risk’ (UHR) state by the CAARMS have relatively low transition rates to psychotic illness over the short to medium term (7-15%) but are likely to experience significant mental health problems, distress and impairment * For this reason ‘screening’ for emerging psychosis should probably be restricted to those who have some indications of ideational and/or perceptual disturbance and are help seeking, distressed and/or have impaired functioning * The PANSS is a widely used symptom rating instrument for use with individuals with an established diagnosis related to the psychosis spectrum * Whilst the PANSS has not been specifically validated for use in those age under 18, with care and sensitivity, it can be usefully employed in adolescents affected by psychosis. |

**Introduction**

Psychosis spectrum disorders have an overall lifetime prevalence of around 2-3% (Kendler, Gallagher et al. 1996). The exact prevalence of psychotic illness in those under 18 is unknown (Hafner and Nowotny 1995) though a Swedish study estimated the prevalence as 17.6 per 10,000 at age 18 (Gillberg, Wahlstrom et al. 1986). A cohort study reporting on outcomes from first episode psychosis reported that 11% of participants had an illness onset prior to age 17 (Amminger, Henry et al. 2011). A separate epidemiological study estimated that 4.7% of individuals diagnosed with schizophrenia became ill prior to 18 (Cannon, Jones et al. 1999). However, approximately 20–40% of adults with a diagnosis related to chronic psychotic illness report the onset was before 20 years (Hafner and Nowotny 1995). Thus, these estimates may be too low. It is likely that a small number of genes interact with other biological and environmental factors to give rise to vulnerability to psychosis spectrum disorders (Craddock, O'Donovan et al. 2009). Once an adolescent-onset psychosis has been established, categorising illnesses diagnostically into the traditional Krapelinian dichotomy of affective disorders versus the schizophrenias shows high levels of stability over time, with the latter associated with a poorer prognosis (Hollis 2000). When these illnesses first develop they are often ‘polymorphic’ in presentation, with a mixture of mood and behavioural symptoms. Whilst substance misuse may trigger an episode, the pejorative label of ‘drug induced psychosis’ may delay access to effective treatment, as well as blaming the individual for their illness (Poole and Brabbins 1996). Accepting that clearly differentiating the schizophrenias from mood-related (affective) psychoses is not always possible this article will focus on the former. This article will use the term ‘psychosis’ as a short hand for illnesses that exclude either mania or depression with psychotic symptoms.

Delays in treatment for psychosis are associated with poorer outcomes (Marshall, Lewis et al. 2005). Thus there have been efforts over the last decade or so to proactively identify, monitor and, in some cases treat, those individuals who may be at high risk of an impending psychotic illness (the ‘ultra-high risk mental state’ (UHR)). This is also sometimes referred to as the ‘At-Risk Mental State’ (ARMS) for psychosis and can be divided into three sub-groups (Yung, Phillips et al. 2003):

* Group 1. The ‘ARMS vulnerability group’ characterised by a significant decrease in (or chronically poor) psychosocial functioning in the context of a genetic risk for schizophrenia.
* Group 2. The ‘ARMS attenuated psychosis group’. These are individuals with psychotic-type symptoms (such as ideational or perceptual disturbance) but the intensity or frequency of such experiences are insufficient to warrant a formal diagnosis related to the psychosis spectrum. Those where the *intensity* of experiences were insufficient for a formal diagnosis are designated ‘Group 2a’ whilst those with subthreshold *frequency* are designated ‘Group 2b’.
* Group 3. Individuals who experience episodes of psychotic symptoms that would ordinarily be of sufficient intensity and frequency to reach the threshold for a formal diagnosis related to the psychosis spectrum. However, such periods of psychosis last no longer than one week and resolves spontaneously without any specific treatment. Psychotic symptoms are brief and self-limiting and may be triggered by stress and/or substance use.

The criteria for the UHR state specify there must be evidence of a recent decline or chronically poor psychosocial functioning (Yung, Nelson et al. 2008). A German research team postulated a fourth group of early-phase at-risk individuals exists, characterised by the presence of subtle, subjective disturbances of cognitive processes and sense of self (referred to as ‘basic symptoms’) (Klosterkotter, Hellmich et al. 2001). Reported rates of transition to psychosis are declining. Indeed, the rates of individuals classified as being in the UHR transitioning, over the short to medium term, to a psychotic illness have dropped to around 15%, and perhaps as low as 7% for adolescents (Welsh and Tiffin 2014) and there has been speculation regarding the reasons for this (Yung, Yuen et al. 2007). Nevertheless, these young people are a group who usually present with a mixture of mood and anxiety symptoms, as well as some degree of perceptual or ideational disturbance. They are vulnerable to a range of mental health problems and may respond positively to psychosocial interventions, such as Cognitive Behavioural Therapy (Morrison, French et al. 2012, Stafford, Jackson et al. 2013). The potential benefits of low-dose antipsychotics in this group may be heavily offset by the high rate of adverse effects (van der Gaag, Smit et al. 2013).

It must be acknowledged that the service context in which a young person is evaluated will influence how the assessment is performed, and by whom. Even across, and within, Western countries the structure of services for those with diagnosed or suspected psychosis may vary widely. For example, in England it is mandated that all 14 to 65 year olds have access to an Early Intervention in Psychosis (EIP) team (National Intitute for Care and Health Excellence 2016). Traditionally not all EIP services include dedicated youth practitioners (Tiffin and Glover 2007), and thus may substantially rely on collaborating with local CAMHS when supporting patients under 18 years. In Scotland such EIP teams exist but have not evolved in as uniform a way. Meanwhile, in low and middle income countries specialist CAMHS may not exist at all, with psychiatrists often working with patients from across the entire lifespan. Thus, a young person’s difficulties may be viewed through varying lenses, depending on the particular professional background and experience of the assessing clinician.

Evaluating psychotic phenomena in young people, as we describe later, is not always straightforward. Therefore it is helpful, even for experienced practitioners, to use structured instruments in order to guide assessment. In this paper we shall compare and contrast two tools designed to support the evaluation of perceptual and ideational disturbance. It is vital, if the resulting scores are to be meaningful, that experiences are captured accurately. Therefore, before the rating instruments are described and critiqued, we describe some practical issues to consider when eliciting and describing psychotic phenomena in young people. Thus, this next section is informed by clinical experience, as well as theory and research evidence, where applicable.

**Exploring potential symptoms of psychosis in young people- some practical principles**

In general, the phenomenology of schizophrenia is similar in adolescence as in those working age adults who develop the illness (Asarnow 1994). However, there are particular challenges to eliciting psychotic symptoms in young people. Firstly, many CAMHS practitioners may not regularly encounter psychotic illness, especially if generally working with children rather than adolescents. Secondly, exploring the phenomenology of psychosis requires sensitive and skilled enquiry and it can be challenging to empathise with those who are undergoing bizarre experiences. For the affected young person the world has often become a frightening and disorientating place, and the prospect of losing one’s mind is, understandably, a terrifying experience. Where suspiciousness or paranoia is present it is valid for a young person to be wary of a professional who is questioning them in relation to their behaviours, thoughts and experiences. There may also be first-hand experience of relatives who have been detained under the powers of mental health legislation. Perceptual disturbance, such as voices, can distract the person during an assessment and this may be apparent to the interviewer. There may be other objective behavioural signs associated with psychotic symptoms such as long pauses after a question is asked. Whilst this can be a sign of formal thought disorder (such as ‘thought blocking’), in the lead author’s experience, it is more commonly associated with a young person deciding how to answer. For example the patient may believe that a disclosure would lead to undesirable consequences.

Additionally, schizophrenia is an illness that assaults the capacity of the individual to appreciate their illness state (i.e. their ‘insight’). Traditionally, the term ‘insight’ has frequently been misused, often as shorthand to express whether the patient agrees with the clinician about the nature of the problem or treatment. Insight is a multidimensional and continuous construct, reflecting the extent to which a patient is aware of the way that the illness has affected them. Also, Sims highlighted that, for the diagnosing clinician, it is the *form* of the patient’s experiences that are most relevant (e.g. ‘*is this belief that the mafia are following the patient delusional or an overvalued idea?*’) (Sims 1995). In contrast, the patient is generally concerned with *content* (‘*what will the Mafia do to me if they get me?!’*). It is also useful to consider the meaning behind the experiences being reported- from a psychoanalytic perspective psychosis can be considered an inability to be able think symbolically (Lucas 2008). Alternatively, cognitive psychology may suggest that in psychosis unusual beliefs may arise from valid, logical attempts to make sense of bizarre experiences (e.g. hallucinations), perhaps in conjunction with anomalies in decision-making processes (Kiran and Chaudhury 2009).

Given the frequent underreporting of psychotic phenomena, it is crucial to draw on collateral information and direct observation when completing rating instruments. Parents, carers, teachers and other professionals may be aware of unusual behaviours emerging. Carers may overhear a young person talking to themselves alone. Suspiciousness may result in the refusal to eat anything but prepacked food. Self-reported symptoms must also be placed in context of any change in day-to-day functioning. In particular, perceptual disturbance (e.g. voice experiences) is common in the general population (Escher, Romme et al. 2002). Moreover, in children with suspected psychosis, hallucinatory experiences, in themselves, are poor predictors of a diagnosis related to the schizophrenia spectrum at one year follow-up (Tiffin and Kitchen 2015). Therefore it is useful to think of psychotic phenomena as being on a continuum of ‘dissociative’ vs ‘psychotic’ experiences, though symptoms may rapidly shift their position in response to stressors or substance use (Tiffin and Morrison 2007). Moreover, one should place particular weight on reported experiences that are accompanied by some objective evidence of impairment in functioning.

In younger individuals psychotic symptoms may commonly co-exist with developmental issues such as Attentional Deficit Hyperactivity Disorder (Asarnow 1994) and Autism Spectrum Disorders (ASD) (Padgett, Miltsiou et al. 2010). It is of interest to note that, historically, childhood autism was classified as a form of psychosis until this conceptualisation was empirically challenged (Kolvin 1971). Nevertheless there is a growing awareness of shared features, as well as some overlap in genetic aetiology between the schizophrenias and the autism spectrum (Pina-Camacho, Parellada et al. 2016). Indeed, one cohort study estimated that a diagnosis of ASD independently increased the odds of reporting psychotic experiences at age 12 by approximately threefold (Sullivan, Rai et al. 2013). Perceptual and ideation disturbance in a young person affected by ASD may sometimes be considered dissociative in nature; a consequence of an affected individual’s difficulty in integrating and processing sensory and emotional information. Delineating such phenomena from an emerging psychotic illness can present something of a diagnostic dilemma (Hayes and Kyriakopoulos 2018).

Having considered some general assessment principles we shall compare and contrast two commonly used instruments used to rate potentially psychotic symptoms. Thermometers are only acceptably accurate over a certain range of temperatures. Likewise psychometric instruments must also be selected as appropriately calibrated according to the trait or ability levels in the population being assessed. Thus, the first assessment tool we shall consider is the Comprehensive Assessment for At-Risk Mental States (CAARMS). The scoring system for this instrument is calibrated with the aim of accurately rating less intense or frequent experiences than would normally be encountered in individuals with an established psychotic illness. In contrast, the Positive and Negative Syndrome Scale (PANSS) is intended to reliably measure changes in psychotic symptoms in those who usually already have an established diagnosis related to the psychosis spectrum. Neither instrument has been designed specifically for use in under 18s, though both have been extensively used in adolescent psychiatric research. Both tools can be used in routine clinical practice as well as service evaluation.

**The Comprehensive Assessment for At-Risk Mental States (CAARMS)**

*Instrument structure*

The CAARMS was developed to support the clinical and research activity of the Personal Assessment and Crisis Evaluation (PACE) clinic based in Melbourne Australia. The instrument was intended to support the operationalisation and definition of the UHR state for psychosis (Yung, Yuen et al. 2005). Table 1 summarises he main characteristics of the CAARMS. It is a semi-structured interview schedule with each of the seven domains having a series of prompts to help the interviewer ask pertinent questions in order to elicit relevant symptoms and behaviours. For example, it is important to establish whether the interviewee has experienced any ‘ideas of reference’ (i.e. a strong feeling or belief that a neutral event or perception has a special meaning, specifically for them). In this respect the CAARMS includes a prompt “*Have you felt that things that were happening around you had a special meaning, or that people were trying to give you messages?*” If the answer is in the affirmative then the CAARMS reminds the interviewer to invite the individual to describe more details about the experience. In these sections the CAARMS provides space on the form for free text answers to the questions to be recorded to support the item codings.

*Scoring*

The CAARMS items themselves are each rated on a six-point Likert scale. Descriptive anchor points are provided to guide the scores, which reflect the intensity of the reported experience or behaviour. Each item is accompanied by a parallel six-point Likert scale, used to code the frequency and duration of the phenomena, as well as their ‘onset’ and ‘offset’ dates. Additionally, each item is accompanied by a three-point Likert scale labelled ‘Pattern of Symptoms’, to record if there is any evidence of the symptom or behaviour occurring specifically in relation to substance use, involving a score of zero (‘no relation to substance use noted’), one (‘occurs in relation to substance use and at other times as well’) or two (‘noted only in relation to substance use’). Some items also have an accompanying visual analogue scale labelled ‘Level of Distress (In Relation to Symptoms)’ to record the reported level of distress from zero (‘Not At All Distressed’) to 100 (‘Extremely Distressed’). These latter two scales are purely descriptive and not used for UHR categorisation purposes. Indeed, only the ratings for the first domain (‘*Positive Symptoms’)*, are used in helping to categorise an individual’s UHR state. As the name suggests, the content is related to the concept of ‘positive symptoms’ in schizophrenia (Crow 1980). This domain is made up of four items; *unusual thought content*, *non-bizarre ideas*, *perceptual abnormalities* and *disorganised speech*. Thus, this section of the CAARMS relates to the disturbances in ideation and perception, as well as the flow of thought that is considered to be a feature of the period leading up to an episode of psychosis, or indeed an established psychotic illness. The other six domains of the CAARMS (*Cognitive Change Attention/Concentration*, *Emotional Disturbance*, *Negative Symptoms*, *Behavioural Change*, *Motor/Physical Changes* and *General Psychopathology)* are not used in classifying UHR state, nor have they been validated in themselves as ratings of behaviours and symptoms in these areas. Therefore they will not be described further here. Indeed, for much of the previous research, and in some routine clinical work that uses the CAARMS, abbreviated versions of the instrument are employed, consisting of the Social and Occupational Functioning Assessment Scale (SOFAS)(Rybarczyk 2011), the positive symptoms domain and usually a small number of key items from other domains. At the time of writing, such a version is available, free of charge from www.rcpsych.ac.uk/pdf/Brief%20CAARMS%20with%20SOFAS%202016.pdf.

It is important to note that any ratings related to symptoms and behaviours in the CAARMS should be placed in the context of the overall reported course of both symptoms and functioning. Indeed, the administrator is initially encouraged to draw a timeline in relation to symptoms and functioning. Moreover, the CAARMS is intended to be performed in conjunction with a rating on the SOFAS (Rybarczyk 2011). The SOFAS is based on the Global Assessment of Functioning (GAF) scale (Morad Aas 2010), but seeks to separate functioning from symptoms. The SOFAS instructs the rater to score an individual’s functioning from a maximum of 100 (‘*Superior functioning in a wide range of activities*’) to ‘1’ (‘*Persistent inability to maintain minimal personal hygiene. Unable to function without harming self or others or without considerable external support…*’). As outlined earlier, evidence for chronically poor, or recently declining functioning, is required in order to designate a young person as in the UHR state. This is indicated as having either a 30% drop in SOFAS score, for at least one month, occurring in the last 12 months, or a SOFAS score of 50 or less for the last year or longer. Administering the initial (‘*Positive Symptoms*’) section of the CAARMS and SOFAS usually takes between 20 and 45 minutes. Completing all domains will take longer, though is unnecessary if the primary aim is to establish whether a young person can be conceptualised as in the UHR state or affected by a psychosis.

Following administration and scoring, an algorithm is completed with three possible outcomes. Firstly, the scores may suggest that the individual fulfils neither the criteria for the UHR state nor for an episode of psychotic illness as the reported symptoms are of subthreshold intensity and frequency and/or the overall functioning of the young person is not impaired. Secondly, the ratings are consistent with conceptualising the individual as being in the UHR state but fall short of those considered to be consistent with an established psychotic episode. This distinction is an important one with implications for treatment strategy. In practice, those scoring above the threshold for psychosis should be considered for pharmacological treatment in line with the relevant NICE Guidelines (National Institute for Care and Health Excellence 2013).

*Psychometric properties*

*Reliability*

The original CAARMS pilot involved a sample of 150 15-29 year old ‘non-psychotic help-seeking’ individuals (Yung, Pan Yuen et al. 2005). Inter-rater reliability was evaluated by comparing blind ratings from seven different raters and 34 participants. The resulting intraclass correlations indicated good to excellent inter-rater reliability (>0.7), with the exception of the ‘*Impaired Energy*’ scale, which is no longer included in the instrument.

*Validity*

The total CAARMS score predicted short-term (12 month) transition to psychosis (as measured by the Brief Psychiatric Rating Scale- BPRS) in those deemed at risk, with the overall score of the pilot version of the CAARMS having an estimated hazard ratio (HR) of 2.16 on survival analysis. However, it is noteworthy that the domain score most closely associated with the risk of transition to psychosis was ‘*Negative Symptoms*’ (HR 1.83). This is a somewhat paradoxical finding as this domain score is not included in the final classification algorithm. However, as the authors point out, within a highly selected subpopulation who are reporting ‘positive’ psychosis-like experiences, it is likely to be the ‘negative’ features, such as declining motivation and functioning, that predicts transition. The authors also reported good ability for the CAARMS scores to discriminate between young people deemed at risk of impending psychosis and a control group recruited from a local unemployment centre. Versions of the CAARMS in Italian (Fusar-Poli, Hobson et al. 2012) and Japanese (Miyakoshi, Matsumoto et al. 2009) have also been validated.

*Alternative instruments*

In North America, for key studies relating to the UHR, the Structured Interview for Prodromal Syndromes (SIPS) has mainly been used (Miller, McGlashan et al. 2003). The SIPS is similar in format to the CAARMS and is used to derive ratings on the linked Scale of Prodromal Symptoms in order to classify individuals into the three main groups of UHR states outlined earlier. There are some modest differences in the criteria between the CAARMS and the SIPS in relation to both defining these UHR categorisations and transition to psychosis (Miller, McGlashan et al. 2003, Olfson, Shaffer et al. 2003). Thus, research findings between studies using the two instruments should be compared only cautiously. Neither instrument offers a clear advantage, in terms of reliability, validity or practicality over the other, though some practitioners may appreciate the breadth of the CAARMS, which offers the opportunity to record a wide range of non-psychotic mental health issues. Moreover, the availability of training and ongoing support for either largely depends on geography, with the CAARMS widely used in the UK and Australasia and the SIPS in the US. In continental Europe there has been a strong emphasis on the concept of ‘basic symptoms’ in relationship to the UHR (see earlier) (Klosterkotter, Hellmich et al. 2001). Instruments such as the Schizophrenia Prediction Instrument–Adult version (SPI-A) are used as part of this approach to categorising the UHR (Schultze-Lutter, Addington et al. 2007). The SPI-A has been adapted for use in young people under 18 as the SPI–Child and Youth version (Fux, Walger et al. 2013). The predictive validity of instruments based on ‘basic symptoms’ alone, or indeed combining them with the more general criteria for the UHR, has not been well established in adolescents, though is a topic of potential research interest. For a more extensive summary of the differing tools used in evaluating the UHR please see Tiffin & Welsh, 2013 (Tiffin and Welsh 2013).

*Further considerations*

Formal training in the CAARMS is highly desirable. However, it is the lead author’s experience that, at least for clinicians experienced in exploring potentially psychotic experiences with patients, the clear anchor points provided by the CAARMS for item scoring often result in acceptable inter-rater reliability even without formal training. However, in the absence of formal training, inter-rater reliability should be evaluated through blind consensus ratings and then assessed using a recognised metric of reliability for ordinal ratings, such as a weighted kappa (Schuster 2004) or Krypendorff’s alpha coefficient (Salkind 2010) .

In terms of dimensionality (that is, the number of constructs likely to be measured by the instrument) a principal component analysis (PCA) has been conducted involving data from 223 patients open to the PACE service (Raballo, Nelson et al. 2011). The findings suggested the presence of three clusters of symptoms/behaviours; those related to negative symptomology (i.e. lack of motivation, affective blunting etc.), those representing disorganisation (e.g. evidence for the presence of formal thought disorder) and those related to ‘perceptual-affective instability’. Some caution should be exercised when interpreting these findings. Firstly, PCA is not well adapted to the analysis of the ordinal data produced from Likert scales- rather an ‘ordinal factor analysis’ is suggested in these circumstances (Muthén 1984). Secondly, as the instrument is rated by clinicians rather than on self-report scores, the data produced should be considered multilevel in nature. That is, some clustering effects by rater may be apparent. Therefore ideally multilevel factor analysis should be conducted unless assurances are given that the rater effects are trivial (Ulitzsch, Holtmann et al. 2017). Lastly, the factor structure of such instruments may vary according to the population evaluated. It is therefore not clear at this point whether the three dimensional structure proposed would hold in a sample of adolescents.

It is also important to note that the European Psychiatric Association (EPA) guidelines on detection of the UHR, based on systematically reviewing and synthesising existing evidence, do not precisely coincide with the CAARMS criteria (Schultze-Lutter, Michel et al. 2015). In particular it is worth noting that, in the recommendations, impaired functioning is viewed as a warning sign of ‘imminence’ of psychosis, rather than a core criterion. Moreover, it was noted that the evidence suggested younger age was associated with lower transition rates. Thus, particular caution was urged when assessing children and younger adolescents from this viewpoint. The guidelines also suggest that assessment should be carried out by, or in conjunction with, a professional experienced in working with those deemed in ‘clinical high risk’ states and restricted to patients who are distressed by their symptoms and help seeking. The guidance from the National Institute for Care and Health Excellence (NICE) for England is less specific, though suggests that children and adolescents suspected of being at risk of an emerging psychosis should be referred to an appropriate service (EIP or CAMHS) and possibly monitored for up to three years. The NICE guidance also suggests consideration be given to psychosocial treatments, such as Cognitive Behaviour Therapy, for such young people, though discourages the potential use of antipsychotic treatment in this group, given the high risk of adverse effects and lack of evidence for benefit (National Institute for Care and Health Excellence 2013). Thus, whilst there are clearly gaps in the evidence relating to the optimum management of the UHR state, especially in younger people, there is some general consensus on management. That is, help seeking individuals with distressing perceptual or ideational disturbance should be assessed by an appropriately experienced mental health professional, monitored and offered psychosocial approaches. The latter could include relatively low key support, such as psychoeducation, but more intensive interventions could be offered if required as part of a stepped-care model (Nieman and McGorry 2015).

There are other issues to consider, such as who, if anyone, should be ‘screened’ for the UHR? Certainly there have been attempts to develop shorter questionnaires, for which it was hoped that appropriate cut-off scores could be used to generate classifications that correspond well to those derived from lengthier instruments. These include the brief ‘Prodomal Questionnaire’ (PQ-B)(Loewy, Pearson et al. 2011). The scores from such instruments correspond relatively well with those derived from, lengthier, semi-structured interviews when deployed in specialist, psychosis-orientated clinics. For example, using an optimal cut-off score the PQ-B achieved a positive predictive value (PPV) of 93% and Negative Predictive Value (NPV) of 46% in a psychosis clinic adolescents and young adults. However, when a 16 item version of the PQ-B (PQ-16) was used in a help seeking group of non-psychotic young adults attending secondary mental health services the cut-off score only corresponded to the CAARMS classification in 44% of cases (Ising, Veling et al. 2012). The PPV and NPV of an instrument are dependent on the prevalence of the target condition in the population screened. Thus, it is unlikely such brief tools will have utility outside of highly specialist settings, unless a high rate of ‘false positives’ (i.e. those scoring above threshold but failing to reach the UHR criteria on more lengthy assessments) are deemed acceptable. Nevertheless, in young people open to CAMHS, where there are some, at least vague, indications of emerging psychosis, use of a brief screen could serve as a useful first stage in assessment. However, in the absence of more specific research in this area the routine use of such tools in young people served by mental health services cannot be recommended.

*Summary*

The CAARMS appears to be a useful tool for identifying young people who are experiencing ideational and perceptual disturbance accompanied by some level of distress and declining functioning. In practice only the domain related to ‘positive symptoms’ is necessary to be completed in order to support the categorisation of the young person (as non/UHR/affected by psychosis) and there are likely to be more widely used and validated instruments to evaluate other domains, such as mood problems or cognitive function. The well-documented declining transition rates to full psychosis in this group of young people suggests that those who fulfil the UHR state are indeed at risk of developing significant mental health problems, and by definition should already have some evidence of impaired day-to-day functioning. However, these problems may not necessarily be within the psychosis spectrum (Welsh and Tiffin 2014). Interestingly, despite the labelling of two of the domains as ‘positive’ and ‘negative symptoms’ (Crow 1980) there is no suggestion that the prediction produced by ratings on the instrument is specifically a diagnosis related to the schizophrenia-spectrum. Certainly, many ‘first rank’ symptoms traditionally considered to be pathognomonic for ‘schizophrenia’ are relatively prevalent in mania (Crichton 1996). Moreover, many ‘UHR’ young people will develop other, non-psychotic mental health problems, such as anxiety or depression, and may respond to relatively low intensity interventions. Additionally it has been highlighted that this group of adolescents often gain great relief by being able to disclose and explore their experiences (Welsh and Tiffin 2012). However, there remains a question: if most of these young people develop *non-psychotic* mental health problems, should it continue to be EIP services (where they exist) that lead on supporting them? Or would other, perhaps more generic, services be better placed to take on this role?

**The Positive and Negative Syndrome Scale (PANSS)**

*Instrument structure*

In contrast to the CAARMS, which focusses on generally milder symptoms, the PANSS has been calibrated to accurately rate more intense psychotic phenomena. These are the kind that may be typically observed in, or reported by, individuals with an established diagnosis related to the psychosis spectrum. Table 1 summarises the principal characteristics of the PANNS. The scale was constructed by combining the 18-item Brief Psychiatric Rating Scale (BPRS) and 12 items from the Psychopathology Rating Schedule (Kay and Singh 1975). The authors state it was mainly developed for the assessment of “….schizophrenic phenomena….” (Kay, Fiszbein et al. 1987). However, the developers state the scale can be used to rate psychotic symptoms in other syndromes. The PANSS is probably one of the most widely used, and researched, psychosis symptom rating tools.

The PANSS rating tool is accompanied by a semi-structured interview schedule (the Structured Clinical Interview- Positive and Negative Syndrome Scale; the SCI-PANSS)(Lindstrom, Wieselgren et al. 1994). An informant questionnaire is also available, used to obtain collateral information and support the scoring of the instrument (Opler and Ramirez 2000). Whilst the PANSS is not a diagnostic instrument as such, there have been attempts to define scoring patterns that define the presence or absence (including remission) of psychotic illness (Wunderink, Nienhuis et al. 2007), and indeed an UHR state, for research purposes (French and Morrison 2004). Moreover, a change of 16 to 24% on the PANSS total score is estimated to represent the ‘minimum clinically important difference (MCID)’ (Hermes, Sokoloff et al. 2012).

The 30 PANSS items are organised into three scales; the positive (P), the negative (N) and the general psychopathology (G) scales, the first two having seven component items and the latter having 16. More recent versions of the PANSS also have three supplementary (S) items relating to ‘anger’, ‘difficulty in delaying gratification’ and ‘affective lability’. However, the exact dimensions underlying item response patterns has been debated (see below).

*Scoring*

Each PANSS item is scored by the rater on a seven-point scale from 1 (symptom ‘absent’) to 7 (‘extreme’). As with the CAARMS, the ‘positive’ scale items are mainly related to ideational and perceptual disturbance. Thus items on the ‘P’ scale include *delusions*, *conceptual disorganisation*, *hallucinatory behaviour* and *suspiciousness/persecution*. Likewise the negative scale is similar to that of the CAARMS, items relating to blunted affect, emotional withdrawal, poor rapport [with the rater] and difficulty with abstract thinking. However, even though a number of the items on the PANSS are labelled almost identically those of the CAARMS, the ratings on the former tool are obviously calibrated as to discriminate between individuals with more intense or frequent potentially psychotic experiences. Brief descriptions for each of the seven scoring points are given in the PANSS manual (Kay, Opler et al. 2000). However, compared to the anchor points incorporated into the CAARMS schedule, the descriptions are, in general, less detailed, giving more room for subjectivity in the scoring. For this reason it is important to undergo formal training in the scoring of the PANSS prior to using the instrument, to ensure that the codings are performed in a consistent and reliable way (Opler, Yavorsky et al. 2017). Training can be obtained via the PANSS Institute ([www.panss.org](http://www.panss.org)). It should also be noted that, unlike the CAARMS which is copyrighted only, the PANSS is subject to licensing restrictions and therefore there is a financial cost to obtaining the materials, which can be purchased via Multi-Health Systems ([www.mhs.com](http://www.mhs.com)).

A number of summary scores can be derived from the item ratings (Kay, Opler et al. 2000). Calculating such summary scores is facilitated by the use of quick score forms. The PANSS provides four syndrome scores (*positive scale*, *negative scale*, *composite index* and the *general psychopathology* scale) and five clusters scores (*anergia*, *thought disturbance*, *activation*, *paranoid belligerence*, and *depression*). These scores can be used to portray a clinical profile for the patient being rated. Syndrome scores are said to provide a reflection regarding the severity and predominance of positive versus negative symptoms. In contrast the cluster scores are said to reflect other symptom dimensions of importance in relation to psychosis, including affective and cognitive functioning. As a result of factor analytic states studies (see below) guidance on an alternative scoring model, based on five dimensions (‘the pentagonal structural model’) is also provided by the manual. This alternative scoring is based on codings from 25 of the 30 PANSS items to produce five summary scores on the dimensions labelled: ‘negative, ‘positive’, ‘dysphoric mood’, ‘activation’ and ‘autistic preoccupation’. Unlike the CAARMS, raters are able to convert raw scores from the PANSS to norm-adjusted T-scores, rescaled to have a mean of 50 and a standard deviation of 10 points. The guidance provided in interpreting such resulting T-scores is based on normative data obtained from 240 treated adults with a diagnosis of schizophrenia. Thus, when interpreting the T-scores produced from assessments in adolescent patients, this limitation must be borne in mind. As with the CAARMS, it is often desirable to rate the instrument in pairs, blindly initially, and then later compare codings, discussing where there are any disagreements. Rating the PANSS using the SCI-PANSS usually takes between 45 and 90 minutes depending on the informant.

*Psychometric properties*

*Reliability*

Analysis of the original pilot data reported relatively high internal reliability-consistency (that is, the degree to which items scorings tended to agree with each other) for the three scales, with Cronbach’s alpha coefficients of 0.73 to 0.83. In patients with chronic psychotic illness (and a DSM-III diagnosis of schizophrenia) test-retest reliability coefficients for the PANSS scale scores were also high, ranging from 0.77 to 0.89 (Kay, Fiszbein et al. 1987). Acceptable levels of inter-rater reliability can be achieved (i.e. weighted kappa values>0.6) with training, which usually involves practising consensus coding from video recorded interviews (Muller and Wetzel 1998).

*Validity*

The authors of the PANSS cite a number of study findings to support the validity of the scale scores. For example, evidence of convergent validity is reported in relation to clinicians’ independent ratings of symptoms and behaviours in individuals diagnosed with schizophrenia (Kay, Opler et al. 1985, Kay, Opler et al. 1986, Kay, Fiszbein et al. 1987). There are a number of studies which examine the ability of the scale scores to predict course in individuals affected by psychosis. Interestingly, relatively high negative scale scores were reported to be associated with a family history of mood psychoses and better outcome at two year follow-up (Lindenmayer and Kay 1987). In this situation, the negative symptoms may have reflected underlying depressed mood, rather than neurocognitive impairment as such. In contrast predominance of the negative scale score in more chronic illness was associated with poorer illness outcomes and functioning (Kay, Fiszbein et al. 1986). The PANSS research-criteria for remission also have some evidence to support their validity, in that those who fulfil this category have a more favourable symptom profile and functioning at 18 month follow-up (Wunderink, Nienhuis et al. 2007).

*Alternative instruments*

A modified version of the schedule specifically for use in children and adolescents (‘Kiddie-PANSS’) has been piloted (Fields, Grochowski et al. 1994). However, the Kiddie-PANSS lacks the experience gained with the original instrument and no formal training in administration is readily available. A diagnosis related to the schizophrenia-spectrum can be made reliably in under 18s applying the adult criteria (Asarnow and Asarnow 1994). Thus it is recommended that CAMHS clinicians wishing to use the PANSS obtain training in the use of the original version (Opler, Yavorsky et al. 2017). There have also been attempts to develop instruments particularly for adolescents in order to quantify psychotic experiences. For example, the Specific Psychotic Experiences Questionnaire (SPEQ) shows promising psychometric properties (Ronald, Sieradzka et al. 2014). However, such questionnaires have often been developed in more general samples of young people. Thus, their routine use as symptom rating scales in clinical populations cannot be recommended at present.

*Other considerations*

A recent review of the literature related to the PANSS concluded it was a valid and reliable rating instrument. However, the authors of the review identified several limitations to the tool which the developers of the instrument had not addressed (Aboraya and Nasrallah 2016). Firstly, the seven-point Likert scale used in PANSS is deemed too detailed, and should probably be a five-point scale (Levine, Rabinowitz et al. 2011). Secondly, the use of a coding of ‘1’ to indicate the absence of symptoms can cause errors when calculating percentage change in scores (Obermeier, Mayr et al. 2009). Furthermore, one of the items (*hallucinatory behaviour)* was criticised for failing to distinguish between sensory modalities, and therefore potentially lack predictive validity (Oertel-Knöchel, Knöchel et al. 2012, Moritz, Veckenstedt et al. 2014). It was highlighted that delusional thinking can be coded across a number of the PANSS items and that some types of delusions may not be captured at all by the scoring. Moreover, ‘bizarre delusions’ relates to item G9 but should probably be placed in the ‘positive symptoms’ sub-scale. Finally, the PANSS cannot be used alone to produce a diagnosis.

Numerous papers have been written describing the potential dimensionality underlying the ratings on the PANSS, though most have supported a pentagonal structure with five factors (latent traits) being measured (White, Harvey et al. 1997). However, only one study has used methods appropriate to the ordinal nature of the item scores and the multi-level structure of the data (Stochl, Jones et al. 2014). The findings from this multi-level ordinal factor analysis supported the pentagonal structure postulated to underlie the responses.

The PANSS structured clinical interview schedule can be helpful to guide the areas of enquiry that need to be covered. However, it is the lead author’s experience that some of the prompts must be adapted for use in younger people. For example, one of the prompts relating to the ‘delusions’/’unusual though content’ items is worded “Do you follow a particular philosophy (any special rules, teachings or religious doctrine)?” This sentence would have to be rephrased to be comprehensible to many young people, for example asking whether they have any particular religious faith or beliefs about spirituality in general. This may open up a conversation about any experiences that the interviewee may construct as having a spiritual dimension. Also, in terms of the item relating to ‘difficulty in abstract thinking’ from the ‘N’ scale, the structured clinical interview for the PANSS suggests evaluating the responses to proverbs. Many of these are well-known sayings, such as ‘too many cooks spoil the broth’. However, in the lead author’s experience, younger individuals are often unfamiliar with the sayings or particular words used (such as ‘broth’), and may encounter more difficulty in providing interpretation compared to working age adults. It could therefore be easier to ask more open-ended questions, such as ‘what does love mean to you?’ in order to assess the quality of symbolic and abstract thinking.

*Summary*

The PANSS provides a useful schedule to explore phenomenology in young people affected by psychotic illness. It is worth noting that, as it emerged from a North American psychiatric tradition, the interview schedule and instrument do not place a particular emphasis on Schneider’s first rank symptoms. With training inter-rater reliability can be achieved and there is evidence for the sensitivity of the scores to change, as well as some prognostic ability of the ratings. There is also evidence to support the use of remission criteria using the symptom scores. Nevertheless, if the PANSS interview schedule is to be used with adolescents then it must be applied with some sensitivity. Also, as with the CAARMS, any symptom ratings derived must be placed in the context of both available collateral information and overall functioning. In addition to being a widely used instrument for research purposes, the PANSS ratings can be important in monitoring routine outcomes for services that support young people affected by psychosis, along with brief measures of functioning (Tiffin and Hudson 2007).

**Conclusions**

Even for clinicians who regularly evaluate young people who are reporting perceptual ideational disturbance, it is often challenging to remember to enquire about all potential relevant domains. Therefore, structured instruments can usefully serve as *aide memoires* in these circumstances. Semi-structured interviews, if conducted sensitively and empathetically, can themselves be therapeutic and help relieve some of the anxiety and sense of alienation frequently felt by young people experiencing such symptoms. Wherever possible collateral information, from carers, teachers, and others, should be sought. Any resulting scores from such instruments should be combined with third-party information, as there are many potential barriers to young people affected by psychotic symptoms being able to accurately disclose internal experiences. Moreover, findings from psychometric instruments should be carefully placed in the context of the recent functioning of the young person and any levels of distress reported observed. When used carefully these schedules are effective tools to support the formulation, and where appropriate diagnosis, of young people affected by potentially psychotic symptoms. They may also be used for research purposes, and to monitor and report outcomes from teams that support young people affected by potentially psychotic symptoms.

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**Ethics**

Not applicable

**Conflicts of interest**

Neither author has anything to declare.

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Table 1. Comparison of the Comprehensive Assessment for At-Risk Mental States (CAARMS) and the Positive and Negative Syndrome Scale (PANSS)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| The CAARMS | | | | |
| Target population | Structure | Administration and scoring | Reliability | Predictive validity |
| 14 to 30 year olds reporting potentially psychotic experiences that could be conceptualised as in a UHR state or affected by a psychotic illness.[[1]](#footnote-1) | 28 items, across 7 domains, rated for intensity, frequency and duration, with pattern in relation substance use and (sometimes) associated distress levels recorded.1  Findings from a principal components analysis suggested the presence of three underlying symptom clusters. [[2]](#footnote-2) | Items ratings generally based on the semi-structured interview with the young person. Administration time varies depending on whether the entire schedule is completed (20 to 45 mins) or only those components required for the categorisation algorithm (45 to 90 mins).  Classification (UHR/Psychosis/Neither) are calculated from the ‘Positive symptom’ scores and SOFAS rating. | Evidence of acceptable Inter-rater reliability (ICC>0.7 for scales).1 | Original pilot results suggested the total CAARMS item score statistically significantly (p=0.002) predicts short term (within 12m) transition to psychosis (hazard ratio 2.16). The single domain score that was most predictive was ‘Negative symptoms’ (hazard ratio 1.83, p=0.0002).1 More recent data relating to adolescents suggest short-term transition to psychosis in this group is relatively uncommon but that almost all will fulfil the criteria for a mental disorder (often anxiety or depression).[[3]](#footnote-3) |
| The PANSS | | | | |
| Target population | Structure | Administration | Reliability | Predictive validity |
| Individuals with an established diagnosis related to the psychosis spectrum. However, validation data generally relates to ratings of working age adults with a DSM-III diagnosis of schizophrenia.[[4]](#footnote-4) | 30 items organised into 3 scales.4  Factor analytic studies of ratings generally support a five dimensional (‘pentagonal’) structure underlying the scoring patterns.[[5]](#footnote-5) | A semi-structured interview schedule (the SCI-PANSS) can be used to guide the collation of information that facilitates item scoring, usually lasting 30-40 minutes.4 An interview schedule is also available to facilitate the collation of information from informants, which assists with scoring some (but not all) of the items.  T-scores can be calculated those these are based on normative data from working age adults with diagnosis of schizophrenia.4 | Relatively high Cronbach’s alpha values are cited for internal reliability consistency for the scales (0.73 to 0.83).4 Acceptable inter-rater reliability is reported to be achieved via training (weighted kappa values for items scores>0.6).[[6]](#footnote-6) | Evidence exists for discriminant and convergent validity. Relatively high ‘N’ scale scores early in illness course tend to predict better outcome, with the converse true in the more chronic illness phase. Those who achieve the PANSS remission criteria tend to have more favourable symptom profiles at 18m follow-up. 4 |

**Abbreviations:** DSM-III- Diagnostics and Statistics Manual of the American Psychiatric Association 3rd Edition, ‘N’ Scale- ‘Negative Symptoms’ Scale, SOFAS- Summary of Functioning Assessment Scale, UHR-Ultra-high risk.

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2. Raballo, A., et al. (2011). "The Comprehensive Assessment of At-Risk Mental States: From mapping the onset to mapping the structure." *Schizophrenia Research* 127: 107-114. [↑](#footnote-ref-2)
3. Welsh, P. and P. A. Tiffin (2014). "The 'at-risk mental state' for psychosis in adolescents: clinical presentation, transition and remission." *Child Psychiatry Hum Dev* 45: 90-98. [↑](#footnote-ref-3)
4. Kay, S. R., L. A. Opler and A. Fiszbein (2000). *The Positive and Negative Syndrome Scale (PANSS): Manual*. North Tonawanda, NY, Multi-Health Systems. [↑](#footnote-ref-4)
5. Stochl, J., P. B. Jones, J. Plaistow, U. Reininghaus, S. Priebe, J. Perez and T. J. Croudace (2014). "Multilevel ordinal factor analysis of the positive and negative syndrome scale (PANSS)." *Int J Methods Psychiatr* Res 23: 25-35. [↑](#footnote-ref-5)
6. Muller, M. J. and H. Wetzel (1998). "Improvement of inter-rater reliability of PANSS items and subscales by a standardized rater training." *Acta Psychiatr Scand* 98: 135-139. [↑](#footnote-ref-6)