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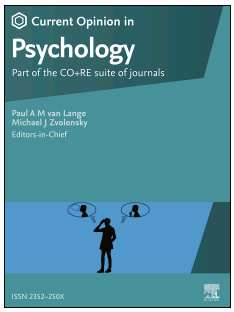

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CReDiT statement

to „Positive psychotic symptoms in childhood and adolescence" by Schultze-Lutter et al.

Frauke Schultze-Lutter: Conceptualization, Literature recherche Roles/Writing - original draft, Writing - review & editing. **Jochen Kindler**: Literature recherche, Roles/Writing - original draft (chapter 4), Writing - review & editing. **Tri Kurniati Ambarini**: Literature recherche, Roles/Writing - original draft (chapter 5), Writing - review & editing. **Chantal Michel**: Literature recherche, Roles/Writing - original draft (chapter 3), Writing - review & editing.

Positive psychotic symptoms in childhood and adolescence

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Abstract

Based on the assumption of a universal neurodevelopmental model of psychosis, especially of the schizophrenia spectrum, the diagnosis (and treatment) of psychosis in minors commonly follows those in adults. Yet, as our review demonstrates, recent years have seen an emergence of studies of minors indicating that developmental aspects may play a crucial role in the prevalence and appraisal of diagnostically relevant positive psychotic symptoms in their full-blown and subthreshold forms, including neurobiogenetic and other risk factors, such as migration. Thus, caution is advised to not overpathologize potentially transient and clinically irrelevant occurrence of (subthreshold) positive psychotic symptoms in the diagnosis and treatment of psychotic disorders and their clinical high-risk states in minors. More studies on developmental aspects are urgently needed.

Key words

psychosis; positive symptoms; children and adolescence; development; diagnosis

Abbreviations

AOP	adult-onset psychosis
APS	attenuated psychotic symptoms
CHR	clinical high-risk of psychosis
COP	childhood-onset psychosis
EOP	early-onset psychosis
OR	odds ratio
PLE	psychotic-like experiences
PPS	full-blown positive psychotic symptoms

1 Introduction

Psychotic disorders clinically present with a broad range of symptoms and impairments. Of these, full-blown positive psychotic symptoms (PPS; hallucinations, delusions and disorganized speech) are the most critical, with at least one of them required for diagnosis of any psychotic disorder [1]. However, PPS are not dichotomic phenomena but the extreme expression on a continuum that, influenced by many factors including neurocognitive (see 3), neurobiogenetic (see 4) and culture-related ones (see 5), ranges from normal to psychopathological experiences [2,3]. This complex nature of PPS and their subthreshold expressions complicates their accurate diagnostic appraisal, leading not only to significant overdiagnosing [3,4] but also underdiagnosing in minors with neurodevelopmental disorders and intellectual deficits [5]. The danger of misdiagnosis in minors may be even more likely with subthreshold expressions of PPS such as attenuated psychotic symptoms (APS). APS are used, among others [6,7], in the early detection of psychosis, that is, in the definition of clinical high risk (CHR) states (Table 1) and of the proposed Attenuated Psychosis Syndrome of the fifth version of the Diagnostic and Statistical Manual of Mental Disorders [8,9]. In light of this, we critically reflect on the clinical relevance of PPS and their various subthreshold expressions (Table 1) in minors, also in terms of their association with neurocognitive deficits and neurobiogenetic aberrations, thereby focussing on clinician-assessed symptoms.

TABLE 1

2 Prevalence and clinical significance of positive psychotic symptoms in children and adolescents

2.1 Positive psychotic symptoms and early-onset psychosis

Schizophrenia-spectrum psychoses have been considered sufficiently diagnostically stable to justify the use of age-independent diagnostic criteria [1,12]. Early-onset psychosis (EOP), with almost 90% of them being schizophrenia diagnoses [13], is defined by illness onset before 18 years-of-age, while childhood-onset psychosis (COP) starts before 13 years-of-age. Assuming that 4% of psychotic disorders start before 15 years-of-age, the prevalence of EOP has not yet been clearly identified [14]. A Danish register study recently reported a very low cumulative incidence of schizophrenia-spectrum disorder around 0.05% before 13 years-of-age, after which it increased until 18 years-of-age to 0.76% in girls and 0.48% in boys [15]. Contrary to these numbers, PPS and their subthreshold expressions, in particular those related to perception, significantly decrease from childhood (median prevalence of 17%) throughout adolescence (median prevalence of 7%) and adulthood (median prevalence of 5%) in the community [16-22]. This opposing trend in the occurrence of psychotic disorders compared to PPS and their subthreshold expressions already implicates what is widely acknowledged; that is, that diagnosing a psychotic disorder is more difficult in minors [1-4,13]. This results in misjudgement of PPS and, consequently, frequent misdiagnoses [3-5] and contributes to the significantly longer duration of untreated psychosis in EOP compared to adult-onset psychosis (AOP) that may be a main

cause of the commonly assumed poorer prognosis of EOP compared to AOP [8]. Table 2 summarizes differences in the clinical picture described between COP and/or EOP, and AOP.

TABLE 2

Furthermore, as PPS reflect a disruption of normal information processing [23-25], certain developmental stages must be reached, that is, certain social-cognitive skills (such as source monitoring [24], reasoning and theory of mind [23]) have to be acquired, before assuming a psychopathological process. Thus, expertise in developmental psychopathology is important when assessing PPS and their subthreshold expressions, in particular in children [3]. Table 3 lists some considerations important in their evaluation.

TABLE 3

2.2 Subthreshold positive psychotic symptoms

The subthreshold character of APS and in particular of psychotic-like experiences (PLE) (Table 1) introduces additional difficulty in clinical assessment and thus, developmentally informed differential considerations (Table 3) have to be observed even more closely. These difficulties are reflected in persistent reports of higher rates of both APS and PLE, particularly hallucinatory ones, in minors compared to adults in clinical and community samples [16,21,27]. APS related to thought content, however, had less clinical relevance in terms of an association with functional impairment in minors compared to adults of the community [16] and, like PLE [28], generally increased risk for a concurrent mental disorder independent of age [16]. Furthermore, PPS and their subthreshold expressions reported by minors had low persistence rates, and multiple but inconsistent predictors for their persistence/remission have been described [19,20]. In a recent meta-analysis [28], PPS and their subthreshold expressions also increased the risk for a mental disorder longitudinally (OR=3.21; 95%-CI: 2.14-4.81), whereby risk for non-psychotic disorders was lower (OR=2.76; 95%-CI: 1.53-4.97) than risk for psychosis (OR=3.96; 95%-CI: 2.03-7.73).

Despite this increased psychosis-risk, minors meeting CHR criteria had lower conversion rates to psychosis [6] although, more often than adults, minors come to early detection services via highly psychosis-risk-enhancing channels, that is, by referral of a mental health professional [29]. Thus, based on much lower conversion rates, community studies indicated only a limited general clinical utility of childhood PPS and APS in predicting psychotic disorder during adolescence and early adulthood [22]. Partly in line with this, a recent study on 8-17-year-old community and inpatient samples [30] suggested that APS in terms of suspiciousness / persecutory ideas might be a transdiagnostic risk factor rather than psychosis-predictive. Yet, APS-based CHR criteria showed no indication of being a pluripotent or transdiagnostic risk factor or even merely a psychopathological severity marker [30]. In a large cohort of 8-22-year-old paediatric, non-psychiatric patients, PLE

targeting on grandiosity (predicting the future) and *Ich-Störungen*, in concert with low functioning, fear of becoming crazy, affective flattening, and unstable neighbourhood, predicted development of APS and psychosis within 2-80 months [31]. Another study comparing predictors between 9- to 17-year-old and 18- to 45-year-old CHR patients reported that conversion was best predicted by negative symptoms in minors and by APS in adults [32]. This finding confirmed earlier assertions that subtle, self-experienced negative symptoms might play a more crucial role in psychosis in minors compared to adults [33].

Overall, these first findings indicate that although current CHR criteria based on APS or brief limited intermittent PPS seem also to be able to predict psychosis in minors, CHR criteria need to be examined in and adapted to the developmental stages of children and adolescents, e.g., by weighting suspiciousness/persecutory ideas, grandiose ideas, *Ich-Störungen* and negative symptoms differently in minors compared to adults.

3 Early-onset psychosis and positive psychotic symptoms, and neurocognition in children and adolescents

Neurocognitive impairment in psychosis is widespread, and neurocognitive impairment in EOP has the same profile as seen in AOP and in CHR patients with APS who convert to psychosis [34], with comparable estimates of average premorbid IQ between EOP and AOP [14] (Table 4). Furthermore, similar patterns of neurocognitive deficits in adolescent and adult CHR patients were reported [35].

TABLE 4

In CHR patients, targeted comparisons of neurocognitive functioning between minors and adults are still few. Age effects were recently reported for mixed-age (minimum age: 12 years), mainly adult CHR samples, pointing towards lesser impairment in younger age [36] (Table 4). These age effects were apparent in processing speed and verbal learning that both differed between CHR patients with and without conversion to psychosis (Table 4). Impairment in processing speed and spatial working memory was found in minors from the community with CHR [37]. Furthermore, the pattern of associations between cognition, and PPS and their subthreshold expressions in children of the community was similar to that seen in schizophrenia, whereby processing speed impairment was a particularly strong predictor of these phenomena in children [22].

With respect to conversion to full-blown psychosis, neurocognitive assessments predicted conversion much better in adolescents than in adults with a CHR state [35]. A study on minor CHR patients reported general intelligence as the only variable predicting conversion, yet it was considered to be a less potent predictor compared to clinical variables [27]. Moreover, longitudinal neurocognitive data indicated that general intelligence remained unchanged in minor CHR patients over one-year follow-up, while progressive impairments were found in executive function and verbal memory, the latter associated with the development of psychotic symptoms [27]. In a cohort study [38], individuals with

a later psychotic disorder showed continually increasing deficits between infancy (18 months) and adulthood (20 years) in full-scale IQ and nonverbal IQ, exhibiting developmental lags in processing speed, working memory, attention, and language and visuospatial ability [38]. Overall, these findings indicate that neurocognitive developmental trajectories may play a more important role in EOP compared to AOP.

4 Early-onset psychosis and positive psychotic symptoms, and neurobiogenetics in children and adolescents

4.1 Genetics

The heritability of schizophrenia is estimated to be as high as 79% [39] and might play a greater role in COP [4]. COP shares considerable genetic overlap with both AOP and earlier-onset neurodevelopmental disorders, such as autism spectrum disorder, whereby the risk architecture of COP involves common and rare variants, including copy number variants [40]. For example, rs16969968 on CHRNA5 was associated with psychotic symptoms and with executive function in EOP [41]. However, comparisons of genetic factors between EOP and AOP are still missing.

4.2 Structural and functional imaging

Psychotic disorders, in particular of the schizophrenia spectrum, are commonly understood as a neurodevelopmental brain disorder, with widespread structural and functional brain alterations [4,42,43]. The patterns of brain alterations in CHR patients and EOP are similar to that in AOP, though less severe in CHR compared to AOP [4,42]. Yet, indicating an effect of age, a larger gap between "brain age" and chronological age predicted conversion only in minor but not adult CHR patients, and surface area decreases in the prefrontal, cingulate, and parahippocampal areas predicted poor symptomatic outcomes, in particular functioning, and negative and disorganization symptoms, only in younger but not older CHR adolescents [44].

Compared to AOP, lower intracranial volume was reported for EOP [45], and less frequent hippocampal grey matter decrease was demonstrated in COP that, consequently, was assumed to emerge only in late adolescence [42]. In a review of the structural neuroimaging literature in mixed-age CHR patients and persons with a positive family history of psychosis, and in EOP/COP [42], the most consistent finding was an accelerated frontotemporal cortical grey matter volume reduction in EOP/COP and in CHR who developed psychosis. Furthermore, over time, the progressive grey matter reduction from posterior to anterior brain regions in COP followed the pattern of normal grey matter decline during adolescence, yet with greater progressive frontal grey matter loss [43].

In a large 8-22-year-old cohort, the group with subthreshold expressions of PPS had diminished whole-brain grey matter volume and expanded white matter volume with significantly lower grey matter volume in the medial temporal lobe, and the frontal, temporal, and parietal cortex [46]. Volume reduction in the medial temporal lobe was correlated with PSS severity [46].

Functional imaging studies indicate a disrupted age-related decrease in amygdala-prefrontal functional connectivity in CHR adolescents and in the psychosis-spectrum group of a 10-25-year-old sample [47]. Additionally, greater age-related deviations in centromedial amygdala-thalamus connectivity were associated with increased PPS severity [47]. Furthermore, response in the amygdala but not in the dorsolateral prefrontal cortex (that was related to neurocognitive deficits) was positively correlated with PPS severity in a large 8-22-year-old cohort [48]. These findings are consistent with disrupted brain connectivity as a vulnerability factor in psychosis, particularly in minors.

5 Positive psychotic symptoms and culture in children and adolescents

Despite the neurobiogenetic bases, the expression of psychosis and PPS is shaped by cultural beliefs, values, and attitudes [49,50], with an estimated culture-sensitive variance of contents of PPS of 15%-30% [50]. Across cultures, for example, *Ich-Störungen* were most frequent in West-African countries, grandiose delusions were extremely rare in collectivistic countries, religious delusions and delusional guilt were more frequent in Jewish-Christian compared to Islamic, Hindu or Buddhist societies, and visual and tactile hallucinations were more frequently reported in cultures that take unexplainable sensory experiences as evidence of the supernatural or divine [50,51]. Cultural effects might also manifest in an overall 1.5- to 3-times increased psychosis risk in migrants [49], in particular when migration was prior to age 18 [52]. Migration before age 18 almost doubled psychosis risk, compared to both no migration (natives) and migration during early adulthood (19-29 years); with no difference between the latter [52].

In underaged community samples, risk of PLE was increased by a background of migration to European countries from non-Western countries (such as the Caribbean, Turkey, and Morocco) [49]. Minority groups from these countries also reported particular high levels of perceived discrimination and disadvantage [49]. Thus, a recent Dutch study of young adolescents did not support a general notion of more frequent PLE in ethnic minority groups [53]. Rather, perceived personal, but not group discrimination, and weak ethnic identity increased PLE; in doing so, discrimination especially increased delusional PLE, while ethnic identity especially increased hallucinatory PLE [53]. This indicates that discrimination, perceived disadvantage, and weak ethnic identity rather than migration status itself increase PPS and their subthreshold expressions in minors, likely also via stimulating neurobiological aberrations (e.g., of the hypothalamic-pituitary-adrenal axis [54]) and neurocognitive deficits (e.g., working memory [55]).

6 Conclusion

Based on the assumption of a universal neurodevelopmental model of psychotic disorders, especially of the schizophrenia spectrum, the diagnosis (and treatment) of psychosis in minors commonly follows those in adults. Yet, a growing body of evidence indicates that developmental factors play an important role in the aetiology and diagnosis of psychotic disorders, PPS and especially their

subthreshold expressions, indicating that minors and adults may require different approaches to the (early) detection and treatment of psychoses [8,9,32,33]. However, the body of evidence is still small, and more comparative studies of minors and adults focussing on the detailed and thorough uncovering of developmental factors, including the negative effects of migration in particular in children, are urgently needed.

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[Based on normative growth charts of amygdala functional connectivity in typically developing youths, this study assessed age-associated deviations of these trajectories in youths with psychosis spectrum disorders (age 10-25), and explored their relations to clinical symptomatology. They demonstrated that the psychosis spectrum group uniquely failed to

exhibit the significant age-associated changes in centromedial amygdala-striatum and centromedial amygdala-occipital connectivity that were seen in the healthy control group, with age-related deviation in centromedial amygdala-thalamus connectivity being positively associated with PPS severity. The authors concluded that, although psychotic symptoms rarely separate clinical samples into discrete groups, these dysfunctions in amygdala functional connectivity may be unique to youths with psychosis spectrum disorders and, in the future, might differentiate psychotic disorders from other psychiatric disorders.]

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Table 1: Comparison of the different concepts of PPS-like phenomena on the continuum of psychosis and their assessments

← normal with no unusual experiences				
	Non-pathological unusual experiences	**Psychotic-like experiences (PLE) [10]**	**Attenuated psychotic symptoms (APS)***	**Full-blown positive psychotic symptoms (PPS)****
Assessment	Commonly not excluded in PLE questionnaires	Mostly assessed by self-report questionnaires incl. CHR screenings	Commonly assessed by clinicians in semi-structured interviews	
Definition level	Clearly phenomeno-logically defined (see below)	Vague, varied definitions, often used as an umbrella term for phenomena across the continuum	Clearly phenomeno-logically defined (see below)	Clearly phenomeno-logically defined (see below)
Thought	Belief is a manifestation of a (sub-) culturally or religiously sanctioned belief system, or appropriate for the developmental phase	Mostly PLEs are defined quantitatively using widely varying assessment tools without specific phenomenological definitions. Descriptions include subpsychotic symptoms located on a continuum between normal experiences and PPS, psychotic-like symptoms in the absence of illness or in non-clinical	Unusual thought contents (incl. unusual thought content of schizotypy) can still be questioned	Delusions are held with full conviction even in the face of contradictory evidence
Perception	Pseudo-hallucination is present exclusively in hypnagogic and/or hypnopompic states, is part of a		Unusual perceptions (incl. unusual perceptual experiences of schizotypy) are self-recognized as being abnormal	Hallucinations are fully externalised; this is experienced as real external stimuli

	religious, spiritual ritual, a (sub-) culturally sanctioned experience, or an externalized phantasy appropriate for the developmental phase	populations, a subclinical psychosis phenotype, or phenomena with doubts about their true psychotic nature due to an uncertainty about the validity of their assessment.		
Speech	Disorganization of speech occurs exclusively in highly emotional states such as anxiety or fear, or in drug intoxication		Attenuated disorganized speech (incl. odd speech of schizotypy) is still well comprehensible and responds to structuring	Disorganized speech must be severe enough to substantially impair effective communication, irresponsive to structuring
Associated diagnoses	None	None	CHR state by APS* and the proposed Attenu-ated Psychosis Syndrome of DSM-5, if recently occurred and currently present in a defined frequency	Any psychotic disorder or, if recent and spontaneously remitting within a couple of days, CHR state by brief intermit-tent psychotic symptoms**
Comment		Commonly reported to overestimate APS/PPS [11]		

CHR: clinical high-risk for psychosis; DSM-5: Diagnostic and Statistical Manual of Mental Disorders, 5th version

* Accounts for a meta-analytical proportion of 85% of all ultra-high risk states [7].

** Accounts for a meta-analytical proportion of only 10% of all ultra-high risk states [7].

Table 2. Differences described in the clinical picture of childhood and/or adolescent, and adult-onset psychosis [1-3,9,12-14].

	Characteristics of a manifestation before the age of 18 years	Group mainly described for
Delusions	• Less elaborated and vaguer, while usually elaborated in adults (except those with intellectual disability)	• children
	• More linked to real experiences	• children
	• Has to be distinguished from irrational or magical thinking common in childhood	• children
	• More often related to hallucinations	• children
	• *Ich-Störungen* correlate more strongly with severity of hallucinations and negative symptoms	• children
Hallucinations	• Often multimodal with higher levels of auditory hallucinations	• children
	• Commenting and imperative voices more common in younger age, while conversing voices more common in adult age	• children
	• Visual hallucinations are more common	• children
	• Often personalized and given names	• children
Disorganized speech	• Often more pronounced and, in some cases with unclear hallucinations or delusions (see Table 2), crucial for the diagnosis of (very) early-onset psychosis	• children / adolescents
Early-onset psychotic disorder	• Poorer premorbid adjustment with higher rates of developmental delays, intellectual and language alterations, and subtle motor delays	• children / adolescents
	• Higher rates of nonspecific emotional-behavioural disturbances, antisocial and aggressive behaviours, and psychopathology, including enuresis and autism spectrum features	• children / adolescents
	• More insidious onset	• children / adolescents
	• Longer duration of untreated psychosis, resulting in poorer outcomes	• children / adolescents
	• Higher levels of bizarre positive psychotic symptoms, of negative symptoms, and of bizarre behaviours	• children / adolescents
	• More severe deterioration and higher suicidality	• children / adolescents

Table 3. Developmentally informed differential considerations in the assessment of potential attenuated (APS) or full-blown positive psychotic symptoms (PPS) [2,3,13,18].

		Group particularly important for
Delusions	• Delusions have been associated with impaired cognitive skills such as reasoning and theory of mind [23]; thus, these should be most carefully diagnosed in younger age groups as these skills continue to develop/mature	• children
	• Delusions have to be distinguished from irrational or magical thinking, or overactive imaginations common in childhood, for example grandiose delusions from beliefs that simply thinking about something will make it happen	• children
	• Paranoid ideas of references have to be distinguished from normal ideas that one was the target of the reciprocal critical or negative attention exclusively of peers (which is a common part of identity formation)	• adolescents
Hallucina-tions	• Hallucinations, in particular verbal ones, have been associated with impaired (meta)cognitive skills such as source monitoring [24]; thus, these should be most carefully diagnosed in younger age groups in that these skills are continuing to develop/mature	• children
	• Hallucinations, in particular visual ones, have to be distinguished from normal fantasy play that is under the child's control	• children
	• Personalized hallucinations have to be distinguished from imaginary companions that, in particular in the presence of adversities and behavioural problems, can persist into adolescence	• children / adolescents
	• It might be harder to assure that hallucinations occur in the context of a clear sensorium, this is not while falling asleep or waking up	• children
Disorga-nized speech	• Disorganized speech has been associated with impaired neurocognitive skills such as working memory and attention [25]; thus, these should be most carefully diagnosed in young age groups in that these skills continue to develop/mature or impaired (for example, in attention deficit disorder)	• children
	• Disorganized speech has to be distinguished from persistent language disabilities	• children /adolescents
	• Disorganized speech has to be distinguished from language impairment in autism spectrum disorder	• children / adolescents

	• Disorganized speech has to be distinguished from odd speech in terms of a schizotypal personality trait	• children / adolescents
General conside-rations to PPS	• Minors with other non-psychotic psychopathology (including anxiety, depression or emerging borderline personality disorder) or histories of adversities, might express distressful internal experiences resembling PPS. Reports of PPS that are situationally specific (e.g., only hearing voices when anxious or only seeing monsters in the dark), overly elaborate and detailed, and/or occur in the absence of more overt thought disorder and disorganized behaviours are atypical for PPS in EOP.	• children / adolescents
	• PPS should be distinguished from resembling phenomena that clearly serve a secondary gain and frequently occur with other non-psychotic mental disorder	• children /adolescents
	• Subthreshold expressions of PPS that are not held with full conviction, are not fully externalized and/or do not substantially impair effective communication should not be rated as full-blown PPS and used for the diagnosis of EOP; rather they should be rated as APS and, where applicable, used to determine a clinical high-risk for psychosis	• children / adolescents
	• Because PPS can also develop secondary to medical conditions [26], a more extensive medical evaluation is necessary in particular in the co-occurrence of delirium, fluctuating mental status, neurologic focal findings, co-occurring physical symptoms (e.g., rash, fever, abnormal movements), and potential exposure to toxins or substances of abuse. For the great variety of warning signs for secondary PPS, the evaluation for potential medical causes should be guided by the clinical presentation and history, rather than broadly screening every patient for every possible condition [26].	• children / adolescents

Table 4: Neurocognitive performance of adult-onset schizophrenia (AOS) and early-onset schizophrenia (EOS) according to a large French sample of 176 EOS and 551 AOS [14] and a review [34], as well as of clinical high-risk (CHR) for psychosis, mainly by APS, and first-episode psychosis (FEP), including estimation of the effect of age, according to a meta-analysis [36]

	Level of impairment in AOS [34]	Impairment in EOS compared to AOS [14,34]	CHR compared to FEP (Hedges' g (95%CI)) [36]	CHR compared to HC (Hedges' g (95%CI)) [36]	Age effect in comparison CHR - HC (meta-regression: beta (95%CI)) [36]	CHR with compared to CHR without conversion (Hedges' g (95%CI)) [36]
Processing speed	severe	similar	0.38 (-0.08 0.84)	-0.39 (-0.56; -0.21) ***	-0.06 (-0.11; -0.01) *	-0.39 (-0.59; 0.19) *** [B]
Attention/vigilance	moderate to severe	less impaired	not reported	-0.39 (-0.49; -0.29) ***	not reported	-0.29 (-0.51; -0.08) **
Working memory	moderate to severe	more impaired	not reported	-0.44 (-0.57; -0.31) ***	-0.2 (-0.7; 0.03)	-0.29 (-0.67; 0.09)
Verbal memory	not reported	not reported	not reported	-0.45 (-0.67; -0.22) ***	not reported	not reported
Visual memory	not reported	not reported	not reported	-0.45 (-0.78; -0.13) **	not reported	-0.44 (-0.74; -0.14) ***
Verbal learning	severe	similar	0.46 (0.30 0.62) ***	-0.51 (-0.63; -0.39) ***	-0.08 (-0.15; -0.01) *	-0.58 (-1.12; -0.05) *
Visual learning	moderate	inconsistent	not reported	-0.43 (-0.57; -0.29) ***	-0.03 (-0.08; 0.03)	not reported
Reasoning/problem-solving	not reported	not reported	not reported	-0.46 (-0.74; -0.19) ***	not reported	not reported
Visuospatial ability	moderate	inconsistent	not reported	-0.32 (-0.44; -0.20) ***	not reported	not reported
Executive functions	moderate	similar	0.34 (0.11; 0.56) *** [A]	-0.42 (-0.60; -0.24) ***	0.001 (<-0.00; 0.00)	-0.42 (-0.77; -0.07)
Social cognition	not reported	not reported	not reported	-0.29 (-0.50; -0.07) **	not reported	not reported
General intelligence	mild	similar [14], more impaired [34]	0.63 (0.35; 0.91) ***	-0.39 (-0.57; -0.20) ***	-0.02 (-0.09; 0.06)	-0.26 (-0.40; -0.11) *** [A]
Premorbid IQ	none	similar	-0.14 (-0.74; 0.47)	-0.38 -0.63; -0.13 ***	0.07 (-0.08; 0.21)	-0.19 -0.54 0.16

* $P<0.05$; ** $P<0.01$; *** $P<0.001$; [A]: No additional age effect in meta-regression; [B]: Additional age effect: beta = -0.08 (95%CI: -0.16; -0.01), $P= 0.028$

Declaration of interests

to „Positive psychotic symptoms in childhood and adolescence" by Schultze-Lutter et al.

☒ The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

☐The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: