



Developmental changes in the endorsement of psychotic-like experiences from middle childhood through young adulthood

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ABSTRACT

Background: Children tend to endorse psychotic-like experiences (PLEs) at higher rates than adults, although little is known about how specific symptom endorsement changes across the span of development. Here we take an observational approach to examine trends in PLE endorsement by age in two non-clinical samples: one of school-aged children and another of late adolescents and early adults.

Methods: Prodromal Questionnaire-Brief (child and adult versions) responses were investigated in individuals ages 9–13 ($n = 11865$) and 16–24 ($n = 3209$) from the Adolescent Brain and Cognitive Development Study (ABCD) and the Multisite Assessment of Psychosis-risk Study (MAP), respectively. Item-level endorsement and distressing item frequencies were examined by age throughout both cohorts.

Results: Unusual perceptual experiences were generally endorsed more heavily in childhood, while other PLEs were endorsed in adolescents and adults up to 4.8 times more frequently than in children. Additionally, certain experiences were endorsed by as many as 73 percent of the older sample.

Conclusions: Considerations for the measurement of PLEs in childhood and adolescence are underscored. Findings from these two samples provide a window into the course of these PLEs and may serve as a scaffold for future research investigating normative versus risk-related experiences during development.

1. Introduction

Psychotic-like experiences (PLEs) are commonly endorsed in the general population as well as in individuals with non-psychotic disorders (Linscott and Van Os, 2013; Bhavsar et al., 2021; Rejek and Misiak, 2023; Rep et al., 2023). These include experiences such as seeing or hearing things that others cannot, feeling that familiar surroundings are strange or unreal, and worrying about the trustworthiness of others (Loewy et al., 2005). Individuals experiencing subthreshold psychotic symptomatology are at an elevated rate for future transition into psychosis and commonly experience co-occurring psychological and functional difficulties (Tsuang et al., 2013; Brandizzi et al., 2014; Reeves et al., 2014; Cooper et al., 2016; Gibson et al., 2016; Korenic et al., 2021).

Children and early adolescents commonly report PLEs at relatively

high rates. Linscott and Van Os found in their systematic review and meta-analysis that younger age was associated with more PLEs in the general community, though the vast majority of these experiences were transient (2013). In a large study of children aged 9–11, 66 percent of the sample endorsed at least one PLE (Laurens et al., 2012). Of these, auditory hallucinations, visual hallucinations, and worries of being followed or spied on were reported most frequently. Another study by Gutteridge et al. (2020) found that 40.3 percent of children aged 9–12 years reported aberrant perceptual experiences which was markedly higher than paranoid ideation and other delusional ideas. These findings suggest that PLEs, and potentially aberrant perceptual experiences, may be more a feature of normative childhood development than previously thought.

While PLEs are common in childhood and most are transitory, they are associated with various psychosocial problems and have been found

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to predict conversion to a full-threshold psychotic disorder in adulthood. A recent population-based study by Sullivan and colleagues found that 60 percent of individuals with a psychotic disorder at age 24 experienced subthreshold psychotic-like experiences at age 12, consistent with past longitudinal findings (Poulton et al., 2000; Sullivan et al., 2020). Additionally, children and adolescents experiencing PLEs have been found to also report other problems related to depression, suicidality, self-harm, anxiety, substance use, and attentional difficulties (Kelleher et al., 2014; Pedrero and Debbané, 2017; O’Hare, Poulton and Linscott, 2021; Jia et al., 2024). Hence, it is critical to understand which PLEs are part of normative childhood development and which PLEs may represent risk for later development of psychiatric difficulties.

Largely, however, research on specific PLEs in the general community remains limited across childhood and emerging adulthood obscuring the developmental course of these experiences. Therefore, we evaluated how specific PLE endorsement changed by age using two large multisite community-based samples spanning school-aged children, late adolescence, and early adulthood with the Prodromal Questionnaire-Brief, one of the most commonly used psychosis-risk self-report instruments (Loewy et al., 2011). The current investigation was conducted largely through an exploratory approach; still, we hypothesized that PLE endorsement would decrease with age and perceptual abnormalities would specifically be endorsed at greater rates in younger individuals.

2. Methods

2.1. Participants

Participants from two large multisite studies were evaluated as part of this study to capture PLEs across the developmental period (see Table 1). Data comprising the child cohort was accessed using the Adolescent Brain and Cognitive Development (ABCD) Study using the NIMH National Data Archive on April 26th, 2022. This dataset (annual release 4.0) was comprised of 11865 children between the ages of 9–10, many of whom returned for 1, 2, and 3-year follow-up assessments. Given the age-related focus of the study, follow-up assessment time-points were only included for children up until age 13 due to

Table 1
Demographics and summary statistics.

Demographics	ABCD	MAP
Sample Size (n)		
Baseline	11865	3209
1-Year Follow-Up	11218	–
2-Year Follow-Up	10387	–
3-Year Follow-Up	6071	–
Female, n (%) ^a	5676 (47.84)	2195 (69.05) ^b
Age at Baseline (years), mean (SD)	9.47 (0.54) ^c	20.03 (1.87)
Race, n (%) ^d		
White	19209 (65.8)	1733 (53.94)
Asian or Asian American	685 (2.35)	804 (25.02)
Black or African American	4329 (14.8)	450 (14.01)
Native American or Alaskan Native	155 (0.53)	1 (0.03)
Native Hawaiian or other Pacific Islander	39 (0.13)	0
More than one race	3517 (12.00)	213 (6.63)
Other	1255 (4.30)	–
Ethnicity, n (%) ^e		
Hispanic	5884 (20.1)	338 (10.32)
Non-Hispanic	23337 (79.9)	2936 (89.68)
Parent or parents born outside US, n (%) ^f	6645 (68.7)	1473 (44.81)

Note: Adolescent Brain and Cognitive Development Study (ABCD) and Multisite Assessment of Psychosis-risk (MAP).

^a Sex assigned at birth.

^b n = 30 selected prefer not to respond.

^c ABCD age in months converted to years for sample comparison.

^d n = 409 (ABCD) and n = 133 (MAP) missing or prefer not to respond.

^e n = 352 (ABCD) and n = 72 (MAP) missing or prefer not to respond.

^f n = 1928 (ABCD) and n = 59 (MAP) missing or prefer not to respond.

insufficient sample sizes above this range. The ABCD Study is an ongoing longitudinal project aiming to collect an array of biological and behavioral data from 21 research sites across the United States over the course of childhood (beginning at age 9) into young adulthood. School selection was determined by a team of epidemiologists and biostatisticians to systematically sample specific public, private, and charter schools which were within a reasonable distance so that the combined sample was representative of the general United States population on an array of sociodemographic variables.

In order to capture the primary ages associated with psychosis risk and transition into a psychotic disorder, 3209 individuals who took part in the Multisite Assessment of Psychosis-risk (MAP) Study were also included (Ellman et al., 2020). This community-based cohort included individuals ages 16 to 30 recruited from the greater Baltimore, Chicago, and Philadelphia areas, although participants ages 25 to 30 were excluded from the current analysis due to limited sample size (as the age range was expanded at a later point in the study). MAP recruitment across sites was conducted using ads posted on a variety of websites and flyers in general community meeting places such as local coffee shops and community centers. Interested participants completed baseline questionnaires remotely over the internet and were compensated for their time. All study procedures were performed in accordance with principles of the Declaration of Helsinki and were also approved by the Institutional Review Boards of the respective data collection sites (Temple University, Northwestern University, and University of Maryland, Baltimore County). All participants completed informed consent (for parents and those over 18) and assent (for minors). Some inherent differences in the community-based recruitment strategies used between the two multi-site studies are expected given the methods needed to appropriately capture a representative sample at different age cohorts.

2.2. Prodromal questionnaire – Brief (PQ-B)

The Prodromal Questionnaire is a 92-item self-report assessment designed as a pre-screener to identify individuals who may be at risk for psychosis and therefore should be followed up with further assessment (Loewy et al., 2005). The PQ positive subscale and its abbreviated version, the PQ-Brief, have been used widely in research and help-seeking settings and demonstrate high sensitivity and low to moderate specificity identifying clinical high-risk states via full clinical interview (Loewy et al., 2011; Savill, D’Ambrosio, Cannon and Loewy, 2018). The full PQ was administered to participants in the MAP cohort, although only the 21 PLEs used in the PQ-B and the PQ-B Child Version (PQ-BC) were investigated in the present study for comparison across samples (henceforth, simply referred to as PQ-B). Participants were asked to indicate via a “yes” or “no” response whether they experienced each item in the last month while not under the influence of alcohol, drugs, or unprescribed medications. Should the participant endorse this experience in the last month, they were then asked if this item was considered distressing to them with a “yes” or “no” response. These responses were used to calculate distressing item endorsement rates. Additionally, if the participant did not experience the parent item in the last month, their response was also captured for the distressing item as a “no.”

2.3. Prodromal questionnaire – Brief Child Version (PQ-BC)

The PQ-BC is a 21-item questionnaire recently modified from the original PQ-B for use in school-aged children (Karcher et al., 2018). Like the original version, the PQ-BC asks for “yes” or “no” responses to experiences outside of substance use in the last month and surveys associated distress. The item wording from each version is listed in full in the supplementary materials.

2.4. Analysis

Frequencies of (a) endorsing each experience irrespective of associated distress and (b) endorsing each experience as distressing for the 21-items in the PQ-B and PQ-BC were calculated and displayed in Figs. 1 and 2 across ages 9, 10, 11, 12, 13, 16 to 19, and 20 to 24. These age bins were chosen to investigate changes in item-specific endorsement across late childhood, early adolescence, teenage years, and early adulthood.

Endorsement rates were also stratified into four PQ subdomains of unusual thinking, persecutory ideation, disorganized communication, and perceptual aberrations similar to past work (Cooper et al., 2016). Individuals who did not respond to an item were omitted from that given frequency calculation. This included between 2 and 4 participants in the ABCD sample and between 14 and 43 participants from the MAP sample depending on the item. (Please refer to the supplementary materials for the full item-by-item response frequencies). Finally, relative risk ratios

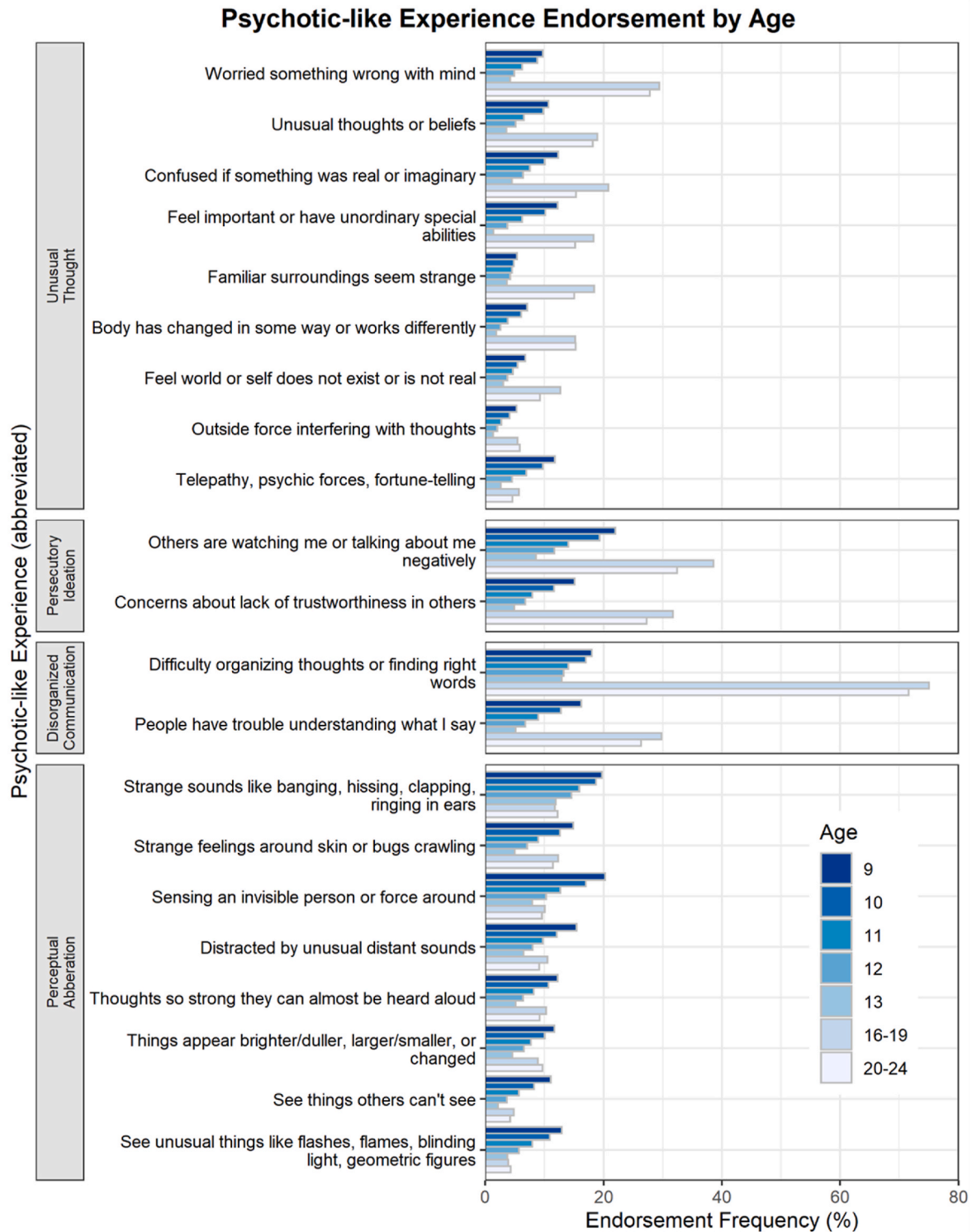


Fig. 1. Psychotic-like experience endorsement by age.

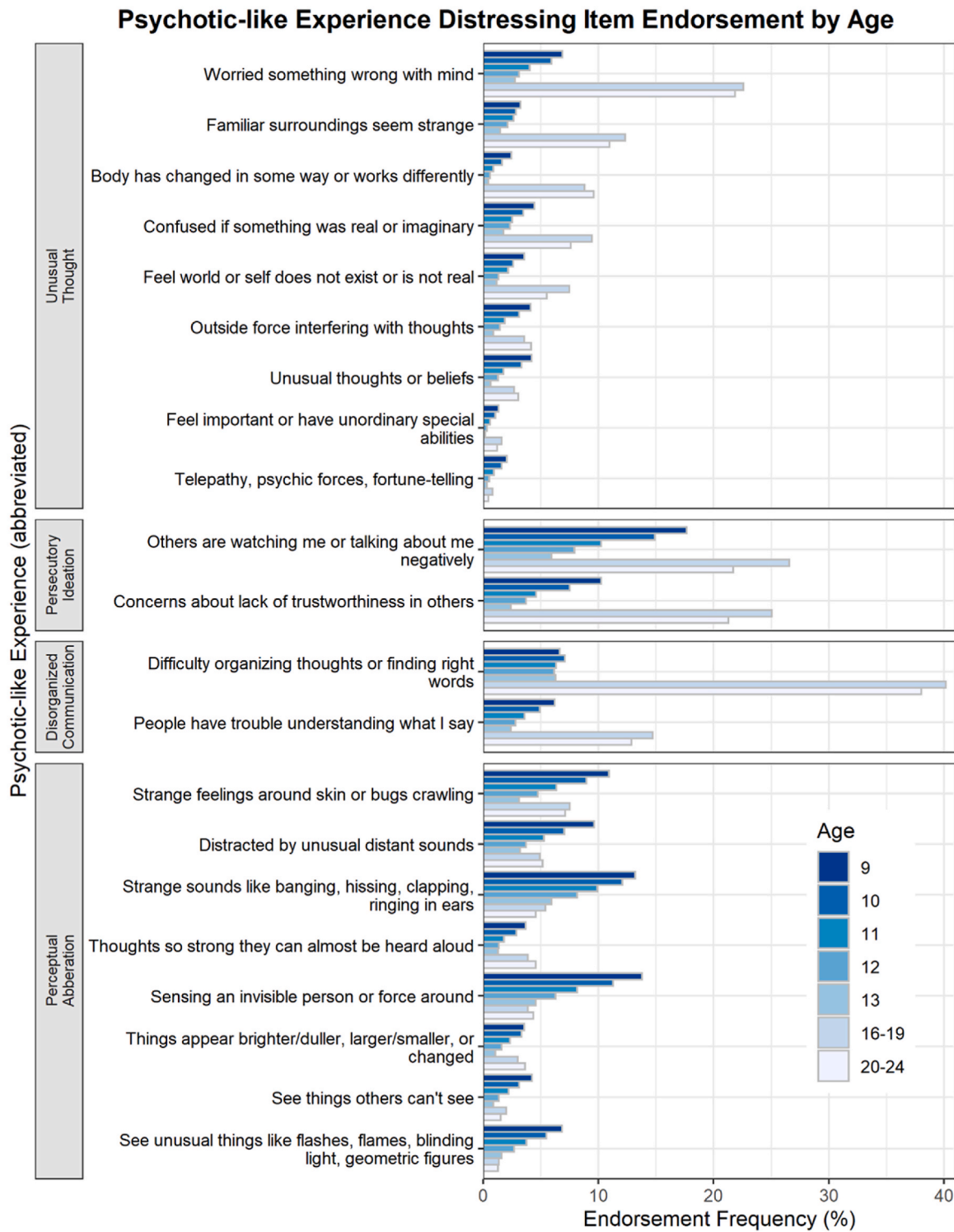


Fig. 2. Psychotic-like experiences endorsed as distressing by age.

were calculated to communicate differences in endorsement by age cohort. Risk ratios greater than one indicate higher endorsement in the adolescent and adult cohort, and ratios below one indicate higher endorsement in the child cohort. Full risk ratios as well as chi-square group differences between age groupings are detailed in the supplementary materials.

3. Results

Both samples were predominantly representative of the communities that they were drawn from with some minor demographic differences between the cohorts. As indicated in Table 1, the MAP sample had a higher proportion of female sex assigned at birth (69.05% versus 47.84%) and participants identifying as Asian or Asian American (25.02% versus 2.35%) than the ABCD sample. Additionally, the

proportion of ABCD participants who had one or more parents born outside of the United States was also somewhat elevated compared to the MAP cohort (68.70% versus 44.81%).

PLE item-specific endorsement frequencies are presented in Fig. 1 by age. All of the items decreased yearly in endorsement between the ages of 9 and 13. In children ages 9 to 13, “others are watching me or talking about me negatively,” “sensing an invisible person or force around,” and experiencing “strange sounds like banging, hissing, clapping, and ringing in ears” were the most commonly endorsed items. Seventy-three percent of individuals between the ages of 16 and 24 endorsed having “difficulty organizing thoughts or finding the right words” in the last month compared to only sixteen percent of children (RR = 4.80). Additionally, a large proportion of participants in their late teens as well as young adults endorsed the items “others are watching me or talking about me negatively” (RR = 2.22), “people have trouble understanding what I say” (RR = 2.67), “concerns about lack of trustworthiness in others” (RR = 3.03), and “worried something is wrong with my mind” (RR = 4.03). PLEs associated with unusual perceptual experiences (e.g., hearing strange sounds like banging, hissing, clapping, and ringing in ears) generally decreased in endorsement with age with the highest levels being in childhood. PLEs measuring persecutory ideation and suspiciousness, disorganized thought, and unusual thought content or delusional ideas appeared to decrease in frequency from ages 9 to 13 and later increase after age 16.

Distressing item frequencies show a similar pattern of endorsement by age. Participants appeared to generally endorse perceptual aberrations as distressing more frequently in childhood, while other PLEs showed a U-shaped pattern of endorsement. Having difficulty organizing one’s thoughts or finding the right words was also the most frequently endorsed distressing item with 39 percent of the adolescent and young adult sample finding it distressing. More than 20 percent of the older sample also experienced distress in conjunction with others watching them or talking about them negatively, feeling concerned about the lack of trustworthiness in others, and worrying that there is something is wrong with their mind.

4. Discussion

This is the first study to investigate specific symptom-level endorsement of PLEs by age over the developmental period associated with psychosis risk. We found that in children ages 9 to 13, PLE endorsement decreased consistently across items with age. Younger children also generally reported the highest frequencies of unusual perceptual experiences, whereas other experiences were endorsed at rates up to 4.8 times higher in adolescents and young adults.

The decrease in self-reported symptoms with age is in line with previous research indicating increased endorsement of PLEs in younger individuals (Poulton et al., 2000; Linscott and Van Os, 2013). Interestingly, this reduction in symptoms with child age was consistent across each PLE. One possible explanation for this finding is that younger participants may be more likely to misinterpret the intended meaning of the questionnaire items. Similarly to how a trained clinical assessor is able to filter out irrelevant client experiences when completing an interview, older participants may consider prior knowledge more heavily when answering a question. For example, one might consider a younger child answering the item, “Did you hear strange sounds that you never noticed before like banging, clicking, hissing, clapping, or ringing in your ears?” differently than an older child based on whether their experiences is truly external, imaginary, or hallucinatory. Another interpretation into these findings is that younger individuals may clinically experience PLEs more variably as Michel and colleagues found in a recent ecological momentary assessment study (2023). Other work found that children who were assessed with a psychiatric interview at baseline and nine days later were unreliable in their responses before age 10 ($\alpha < 0.70$) but increased in reliability with age (Edelbrock et al., 1985). Parental retest reliability was found to be consistent across the

ages, but to decrease slightly over time. Another study by Edelbrock et al. (1986) of youths ages 6 to 18 found low parent-to-child agreement on psychiatric interview symptom reporting at younger ages for internalizing symptoms such as anxiety, obsessions, and psychotic symptoms. The authors suggest that this may be due to participants misunderstanding the essence of the questions or misrepresenting their own personal experience. Similarly, Laurens et al. (2012) found that children reported significantly more PLEs through self-report than were rated as PLEs during a full clinical interview. Horwood et al. (2008) found that 38.9 percent of children reported at least one PLE using self-report; however, only 13.7 percent of children were found to have ratable PLEs when followed up with a clinical interview with a trained assessor. Similarly, Laurens et al. (2007) found that children ages 9 to 12 reported more PLEs than parents rated for the same children. This may again be due in part to children misunderstanding the questionnaire or because parents are unaware of the totality of their child’s inner experience. In line with the latter explanation, parent-child rating agreement has been found to be more consistent with externalizing symptoms compared to internalizing symptoms which often have ambiguous wording or subject interpretation (Angold et al., 1987; Herjanic and Reich, 1982). Taken together alongside longstanding research that self-report reliability increases with cognition during development, there is some evidence that the PQ-BC may be most reliable in late adolescence. Still, examining child ratings alongside clinician-administered interviews is necessary in future work.

In participants ages 16 to 24, certain items were endorsed by a large proportion of individuals such as having difficulty organizing one’s thoughts or finding the right words which was endorsed by almost three quarters of participants. Other items were endorsed by over 20 percent of late teens and young adults such as worries that others were watching them or talking about them negatively, others are untrustworthy, something is wrong with one’s mind, people have trouble understanding what one says. The rates of endorsement on these items mirror endorsement frequencies observed in a recent study from our research group examining the PQ in young adults from the Philadelphia community (Capizzi et al., 2022). There, we found that responses on similar highly endorsed items were not associated with corresponding ratings when participants were probed about these experiences via a full-length clinical interview. Therefore, it is likely that these highly endorsed experiences found in the present MAP adolescent and adult age groups represent more normative experiences unrelated to psychosis risk and removing these items may increase the specificity of the measure (Capizzi et al., 2022). Interestingly, these items were not found to be highly endorsed in a previous study by Loewy et al. (2007) in a University of California, Los Angeles undergraduate sample, potentially due to convenience sampling methods. For example, this study reported 24, 43, and 4 percent Caucasian, Asian, and black or African American participants, respectively, which differ appreciably from national demographic characteristics (Bureau, U.C., 2021).

The change in item-specific PLE endorsement over the age bins showed that many items that were associated with persecutory ideation, disorganized communication, and unusual thought content were endorsed in late teens and adults two to three times more frequently than school-aged children. This large increase in endorsement may be explained by several plausible factors such as increases in social anxiety or concerns about cognitive functioning that come with the transition to adulthood and movement into secondary education, although these were not examined in the current report (Langston and Cantor, 1989; Nordstrom et al., 2014; Gray et al., 2016; Lefler et al., 2021). Although both cohorts used similar techniques to recruit participants from the general community, some differences remain which may in part contribute to the current findings. The older cohort had more Asian and African American participants (25%) than the younger group (2%). Additionally, the younger cohort had a greater percentage of one or more parents born outside of the United States (69% vs 45%). In general, however, the ethnoracial breakdown between the child and adult

cohorts are similar and represent an overall strength of the study.

Interestingly, unusual perceptual experiences and associated distress were highest in childhood and decreased steadily with age into adulthood. As previously discussed, this may be due to a misinterpretation of item intent at younger ages and/or normative experiences during these periods. Notably, childhood PLEs are difficult to assess and parse apart from normative pretend play and engagement with imaginary companions. It is estimated that between 33 and 66 percent of school-aged children engage with imaginary companions (Fernyhough et al., 2019). Engagement has also been associated with positive developmental outcomes like superior social cognitive abilities and increased creativity (Fernyhough et al., 2019; Taylor et al., 2004). Unlike imaginary companions, PLEs or frank hallucinations are not typically experienced as being created willfully by a child (Slade and Bentall, 1988). These important differences may in part explain the reduction in abnormal perceptual experiences with age, as children begin to engage with imaginary companions less frequently. Future work should consider how wording may be adapted to better differentiate these two seemingly unique experiences.

While this study benefited from large sample sizes and is ostensibly the first direct investigation of PQ-B item endorsement over the age span of psychosis risk, there were some limitations. The late teen and early adulthood sample did not assess symptoms longitudinally, so we were unable to model for within-individual changes in PLE endorsement with age. This study also did not assess participants by full clinical risk interview, which makes interpretation of the validity and reliability of some of the results more difficult. Future work should evaluate self-report PLEs longitudinally in conjunction with clinician-led interviews to ascertain stability of symptoms overtime within individuals and the reliability of specific items. Additionally, the current study did not examine PLE relationships with gender, racial, ethnic, or cultural identities. These are important avenues for future work given that experiences which are expected, protective, and normative for certain populations should be carefully considered before being categorized as risk related. Still, self-report measures like the PQ-B are intended to be followed up by full interview where these nuances can be evaluated with more care. Notably, there has been a shift in that the majority of research to date with the PQ-B, including the present study, has been in community-based samples in contrast to earlier help-seeking investigations (Savill et al., 2018). While the intent of the current investigation was to better understand more general responding, it should be noted that the PQ was originally developed for use with help-seeking individuals to identify those at risk for psychosis and therefore may function differently depending on the method used (Fusar-Poli, 2017). Despite this, individuals in community samples endorsing concomitant PQ distress have been suggested to hold similarities to help-seeking individuals and thus may be more informative (Schultze-Lutter et al., 2015). Finally, although the PQ-BC has been validated for use in children and demonstrates similar demographic measurement-invariance properties to the original version, item wording has been adapted for use in children and thus represents an additional limitation when comparing rates of endorsement (Karcher et al., 2018).

The assessment of psychotic-like experiences via quick self-report measures remains a useful tool to screen individuals who may be experiencing prodromal symptomatology. A primary takeaway from this study that school-aged children experience psychotic-like experiences at relatively high rates is consistent with past literature and should be considered carefully by clinicians working with pediatric populations so as not to over-diagnose or stigmatize a potentially common occurrence. Still, these experiences should be taken seriously, particularly when they are accompanied by distress. Clinicians may choose to collect collateral information on these experiences from other informants to gain a wider understanding of their presence and track stability at these early ages. More work is needed to provide more specific recommendations for clinicians assessing developmental differences in the experience of PLEs. Future initiatives to expand identification of individuals prior to

psychosis onset will benefit from ecologically valid measures which are fine-tuned for use in the general population. The current study observed item-specific and total PLE endorsement from school-aged children through early adulthood in the general community and may serve as reference for future investigations in these populations.

Ethical standards

The authors assert that all procedures contributing to this work comply with the ethical standards of the relevant national and institutional committees on human experimentation and with the Helsinki Declaration of 1975, as revised in 2008. The authors also assert that all procedures contributing to this work comply with the ethical standards of the relevant national and institutional guides on the care and use of laboratory animals.

Contributions

RC designed the current project, conducted the analysis, and wrote the primary draft of the manuscript. JK supervised the analysis and revised further versions of the manuscript. LME supervised all components of the project, wrote the MAP study grant, and contributed to each version of the manuscript. SAK, KSFD, TV, VAM, and JS revised and contributed to further versions of the manuscript and VAM and JS are MPIs on the MAP grant. All authors approve of the manuscript in its current form.

CRedit authorship contribution statement

Riley Capizzi: Conceptualization, Formal analysis, Methodology, Writing – original draft. **Stephanie A. Korenic:** Methodology, Writing – review & editing. **Joshua Klugman:** Methodology, Writing – review & editing. **Katherine S.F. Damme:** Writing – review & editing. **Teresa Vargas:** Writing – review & editing. **Vijay A. Mittal:** Funding acquisition, Project administration, Writing – review & editing. **Jason Schiffman:** Funding acquisition, Project administration, Writing – review & editing. **Lauren M. Ellman:** Funding acquisition, Methodology, Project administration, Supervision, Writing – review & editing.

Declaration of competing interest

None.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.jpsychires.2024.05.034>.

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