**Letter to the Editor**

**Metacognition and psychosis-spectrum experiences: a study of objective and subjective measures**

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Metacognition, thinking about thinking, involves activities ranging from discrete to integrative abilities, referring to: 1) awareness of one’s cognitive abilities and biases, 2) beliefs about thought processes, and 3) ability to integrate information to understand the self and others (Klein and Pinkham, 2020).

Metacognition is often impaired in people with psychosis,and deficits are associated with experiences such as hallucinations (Varese and Bentall, 2011) and delusions (Sterzer et al., 2018). Metacognitive interventions can improve metacognition, whichis related to clinical improvement. However, assessments of metacognition often vary in administration duration, and subjectivity.

This cross-sectional online study 1) investigated differences between participants experiencing a psychosis-spectrum disorder (PSD, n=24) and controls (n=44) on in-the-moment objective and retrospective self-report measures of metacognition, 2) explored the predictive nature of metacognition on hallucinations and delusions, and 3) the relationship between different measures of metacognition. We expected that metacognition would be worse in PSD compared to controls, and that worse metacognition would be correlated with and predict higher scores of hallucinations and delusions in PSDs.

Ethical approval was obtained through the University of Southampton Research Ethics Committee. Participants were over 18 years old, residing in the UK. Participants were recruited via an online recruitment platform, and social media; controls were also recruited from the University of Southampton’s research participation portal. Controls reported no previous experience of a psychotic disorder. Participants were paid £4.50 or awarded student research credits.

Demographic information (age, gender, ethnicity) was collected. Metacognition was measured using the: Beck Cognitive Insight Scale [BCIS; self-reflectiveness sub-scale (Beck et al., 2004)], Metacognition Self-Assessment Scale [MSAS; metacognitive abilities(Pedone et al., 2017)],and meta-Dots task [metacognitive accuracy (Rouault et al., 2018)]. Symptoms were measured using the Multi-Modality Unusual Sensory Experiences Questionnaire [MUSEQ (Mitchell et al., 2017)]andthePeters Delusion Inventory [PDI-21 (Peters et al., 2004)]. All measures were validated in clinical and control populations.Anonymised data and supplementary materials are available: https://osf.io/t4d39/

Mean age for PSD participants was 36.0 years (SD=12.07) and 22.02 years (SD=5.49) for controls. 43% of PSD participants identified as women, compared to 75% of controls (See Supplementary Tables). Gender and age were included as covariates in all analyses as these significantly differed between groups. The PDI total score had a slight negative skew and was square root transformed for analyses.

ANCOVA demonstrated significant between-group differences in PDI-total, F(1,63)= 40.47, p=<.0001, η2 =.39, and PDI-distress (about delusions), F(1,63) =52.11, p=.00, η2 = .45, PDI-conviction (about delusional beliefs), F(1,63) =41.63, p=.00, η2 =0.40 and PDI-preoccupation (with delusional beliefs), F(1,63) = 53.74, p=.00, η2 =0.46. The PSD group scored higher on each subscale. Group differences were found in MUSEQ-total F(1,63) =37.24, p=.00, η2 = .37, where the PSD group reported more hallucinations.

ANCOVA revealed significant group differences in metacognitive abilities: MSAS-total F(1,63) = 5.01, p=.008, η2 = .07, where the control group had higher scores (PSD: Mean=59.67, SD=10.26); Control: Mean=67.02, SD=12.50). There were no group differences in BCIS self-reflectiveness or metacognitive accuracy (See Supplementary Tables).

This study may have been underpowered to detect some differences, however, sensitivity analyses indicated sufficient power concerning the MSAS.

In the PSD group, MSAS-total was correlated with PDI sub-scales distress (r=-.472, p= .023) and preoccupation (r=-.527, p=.007), but there were no associations between measures of metacognition. In the control group, there were significant correlations between MSAS-total and BCIS-self-reflectiveness, (r=.421, p=.004) and MSAS-total and metacognitive accuracy (r=.375, p=.012; see Supplementary Tables).

Regression analyses in the PSD group demonstrated that no measures of metacognition were predictive of MUSEQ-total score. The MSAS-total significantly predicted PDI-distress (B = -.481, p = .02) and the full statistical model was significant R2= .23, F(1, 22) = 6.32, p=.02. It was also correlated with PDI-conviction (B = .278, p = .01) and the full statistical model was significant R2 = .27, F(1, 22) =8.08, p=.01. Assumptions regarding multicollinearity, homoscedasticity, homogeneity of variance, and normality of random effects were met.

Controls scored higher on self-reported metacognitive abilities (MSAS-total and MSAS-integration), consistent with previous literature. To our knowledge, this is the first study to use the MSAS in a community sample of individuals experiencing PSD. We found no difference in BCIS self-reflectiveness. Research has reported comparable self-reflection in some clinical groups, and higher self-reflection is associated with better functioning in PSD (Rathee et al., 2018). PSD participants in our study were living in the community, so may have better overall functioning and/or be further along in their recovery.

There was no significant group difference in metacognitive accuracy, likely because our task used a staircase procedure to maintain task performance around 70%; recent meta-analyses report no group differences in in-the-moment metacognition when performance is controlled (Rouy et al., 2021).

We identified negative associations between self-reported metacognitive abilities (MSAS-total) and both distress about and preoccupation with delusional thoughts (PDI), in the PSD group. Poorer metacognitive abilities may impede awareness of delusional thoughts, and thus increase distress and preoccupation with them.

No measure of metacognition was associated with or predicted hallucinations in either group. We suggest this may be due to our method of measuring metacognitive abilities (MSAS), which addressed different metacognitive constructs compared to previous literature, such as metacognitive beliefs (Varese and Bentall, 2011). This indicates that subtle differences in conceptualising and measuring metacognition can result in different associations with symptoms.

In the PSD group, there were no significant correlations between measures of self-reported retrospective metacognition, or in-the-moment metacognitive accuracy. In the control group, metacognitive abilities (MSAS) were significantly correlated with metacognitive accuracy and self-reflection (BCIS). Although conceptually similar, these measures are not examining the same constructs, suggesting a disconnect between metacognitive processes in PSD, whereby there are deficits in retrospective measures of metacognitive abilities but not in-the-moment metacognitive accuracy (Rouy et al., 2021). Measures used to assess metacognition may yield different results concerning group differences and associations with symptoms in PSD and control groups. This has important implications for conceptualising metacognitive deficits in PSD. Researchers and clinicians must be clear on what metacognitive constructs, such as discrete or integrative abilities, they wish to measure and utilise appropriate assessment methods.

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