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Highlights

- This exploratory study examined the role of inner speech in the experience of auditory verbal hallucinations (AVHs) and delusions.
- Greater levels of dialogic inner speech were found in participants with psychosis compared to non-clinical controls.
- Greater levels of dialogic inner speech reported better relations both with and between their voices.
- Qualitative narratives also highlighted the tangled dynamics of inner speech, AVHs and delusions.
- These results underscores the need for phenomenological and clinical research into the potential interrelatedness of inner speech, voices and delusions, and the complexities involved in disentangling this network of inner experience.

RUNNING HEAD: INNER SPEECH, VOICES, AND DELUSIONS

The tangled roots of inner speech, voices and delusions

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Abstract

The role of inner speech in the experience of auditory verbal hallucinations (AVH) and delusions remains unclear. This exploratory study tested for differences in inner speech (assessed via self-report questionnaire) between 89 participants with psychosis and 37 non-clinical controls. We also tested for associations of inner speech with, i) state/trait AVH, ii) AVH-severity; iii) patients' relations with their voices, and; iv) delusion-severity. Persons with psychosis had greater levels of dialogic inner speech, other people in inner speech, and evaluative/motivational inner speech than non-clinical controls. Those with state, but not trait AVH had greater levels of dialogic and evaluative/motivational inner speech than non-clinical controls. After controlling for delusions, there was a positive relation between AVH-severity and both evaluative/motivational inner speech and other people in inner speech. Participants with greater levels of dialogic inner speech reported better relations both with and between their voices. There was no association between delusion-severity and inner speech. These results highlight the fruitfulness of better understanding relations between inner speech and AVH, provide avenues for future research, and underscore the need for research into the interrelatedness of inner speech, voices and delusions, and the complexities involved in disentangling these experiences.

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Key Words: Inner Speech, Auditory Verbal Hallucinations, Voices, Delusions

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1. Introduction

Auditory verbal hallucinations (AVH) are sensory experiences that occur in the absence of external stimulation. While there are multiple models of AVH (Jones, 2010), one influential model proposes they result from misattributed inner speech (Frith, 1999; Seal et al., 2004; Jones and Fernyhough, 2007a, 2007b). Inner speech, the subjective experience of language in absence of overt, audible articulation (Alderson-Day and Fernyhough, 2015), has notable phenomenological parallels to AVH (Jones, 2010). These have led figures across the centuries, including the Spanish mystic, St. John of the Cross (1542-1591) and French psychologist Eggers (1848-1909), to propose that persons with AVH are simply speaking to themselves without realizing it (McCarthy-Jones, 2012).

Highly suggestive evidence for a role of inner speech in AVH comes from the increased activity in speech musculature accompanying AVH (Rapin et al., 2013). However, other evidence is equivocal. Evidence that blocking inner speech reduces AVH (Bick and Kinsbourne, 1987) has failed to be replicated (Green and Kisbourne, 1990). Activation of left Broca's area during AVH has been taken as evidence of speech production processes occurring (McGuire et al., 1993). However, a recent study found that whereas planned inner speech activated left Broca's area, naturalistic inner speech did not (Hurlburt et al., 2016), raising questions over whether activation of left Broca's area during AVH is in fact evidence of inner speech production occurring (McCarthy-Jones, 2017).

A number of studies have explored the relations between the phenomenology of inner speech and AVH. This has been done in both clinical (de Sousa et al., 2016; Hurlburt, 1990; Langdon et al., 2009) and non-clinical (Alderson-Day et al., 2014; Perona-Garcelán et al., 2017;

Tamayo-Agudelo et al., 2016) samples. We focus here on research relating to clinical populations, as it remains unclear if the findings from non-clinical samples can be generalized to clinical samples.

An early study by Langdon et al. (2009), compared the inner speech of 29 persons diagnosed with schizophrenia who were experiencing AVH to that of 42 (non-voice hearing) controls. It was firstly of note that persons diagnosed with schizophrenia were able to clearly differentiate between their own inner speech and the voices they heard. This was consistent with the earlier findings of Hoffman et al. (2008) and reiterated that inner speech and AVH were separable phenomena representing valid targets of research. Langdon and colleagues found that the inner speech of persons diagnosed with schizophrenia was "almost identical in all respects" to that reported by controls (p. 655). However, they noted an interesting trend (p=0.08) towards persons with AVH being less likely to experience their inner speech as a dialogue with themselves. The authors called for further, better-powered research into this relation.

One limitation of the Langdon et al. (2009) study was that it did not use a formal psychometric tool to assess inner speech. Instead it relied on single questions about specific aspects of the inner speech experience. In contrast, a recent study, by de Sousa et al. (2016), examined the relation between hallucinations and inner speech using a psychometrically validated self-report measure of inner speech; the Varieties of Inner Speech Questionnaire (VISQ; McCarthy-Jones and Fernyhough, 2011).

The VISQ measures four specific dimensions of inner speech; Dialogic Inner Speech, Condensed Inner Speech, Other People in Inner Speech, and Evaluative/Motivational Inner Speech. These properties of inner speech were identified as being of importance by the originators of the VISQ based on a Vygotskian conception of inner speech (Vygotsky,

1934/1987). The *dialogicity* of inner speech (its tendency to involve a back-and-forth, conversational quality; Alderson-Day and Fernyhough, 2015), is proposed to arise from its developmental roots in the internalisation of external dialogues with others (Fernyhough, 2004; Vygotsky, 1934/1987; Wertsch, 1980). This dialogue is initially internalised as full, expanded speech, but comes to be *condensed* through a process of syntactic and semantic abbreviation (Fernyhough, 2004, 2009; Martínez-Manrique and Vicente, 2010). The origin of inner speech in external dialogues mean that it should feature different voices in interaction, and be shot through with *other's voices* (Fernyhough, 1996). Key functions of inner speech appear to include *evaluating and motivating* oneself (Hardy et al., 2005; Morin et al., 2011).

De Sousa et al.'s (2016) study, employing the VISQ, was performed with 80 persons with a psychosis-related diagnoses (schizophrenia, schizoaffective disorder, 'other psychosis') and 30 non-voice hearing, non-clinical controls. Of relevance to our present study, analyses undertaken included testing for an association between VISQ scores and i) the presence of psychosis per se, ii) the severity of hallucinations, and iii) the severity of delusions. Persons with a psychosis-related diagnosis were found to have significantly greater scores on Other People in Inner Speech and Condensed Inner Speech, relative to controls. Hallucination severity was positively associated with Evaluative/Motivational Inner Speech, but this relation did not survive a correction to alpha for multiple testing using the conservative Bonferroni correction. Hallucination severity was also positively associated with Other People in Inner Speech; a relation which remained significant not only after a Bonferroni correction but also after controlling for levels of delusions. As the authors noted though, these findings were "perhaps unsurprising given that auditory hallucinations take the form of the voices of others" (p. 890).

Yet participants were asked to report specifically on their inner speech rather than their voice-hearing experiences.

Despite de Sousa et al.'s (2016) study arguably using a better measure of inner speech than Langdon et al. (2009), it also had a number of limitations. First, it assessed hallucinations using the hallucinations item of the Positive and Negative Syndromes Scale (PANSS, Kay et al., 1987). The hallucinations item on this measure is non-modality specific, hence potentially measuring visual, tactile and olfactory hallucinations, in addition to the modality of interest; auditory verbal hallucinations. Second, by only undertaking correlations between inner speech experiences and the severity of hallucinations, this study was only designed to assess whether inner speech was associated with state AVH. It was not designed to assess whether certain forms of inner speech could predispose people to AVH. This would need to be assessed by testing for differences in inner speech differ in those with current AVH, those with remitted AVH, and non-clinical controls.

Our current study aimed to build on the exploratory work of Langdon et al. (2011) and de Sousa et al. (2016) to better understand the relations between inner speech and the specific experiences of AVH and delusion. Following de Sousa et al. (2016), we first aimed to compare VISQ scores between persons with psychosis and a non-clinical control group (who had never received a diagnosis of a psychiatric disorder and did not experience AVH). Here, following de Sousa et al., we hypothesized there would be greater levels of Other People in Inner Speech and Condensed Inner Speech in persons with psychosis.

The second aim of the current study was to assess the association between VISQ scores and both the presence and severity of AVH. Associations between the presence of AVH and VISQ scores were to be assessed by comparing VISQ scores between persons with psychosis

with current AVH (state AVH), those with history of AVH but none currently (trait AVH), and non-clinical controls. In order to assess the association between VISQ scores and the severity of AVH, we aimed to examine correlations between VISQ scores and the severity of AVH.

Following de Sousa et al. (2016) we hypothesized the Other People in Inner Speech subscale of the VISQ would be positively associated with both the presence and severity of AVH. Hypotheses on the relation between Motivational/Evaluative Inner Speech and AVH drew on the high prevalence of evaluative comments and commands in AVH (Nayani and David, 1996; Rosen et al., 2011; McCarthy-Jones et al., 2014), and de Sousa et al.'s (2016) finding (pre-Bonferroni correction) of a positive relation between hallucination severity and the Evaluative/Motivational subscale of the VISQ. This led us to hypothesize a positive association between the Motivational/Evaluative Inner Speech subscale of the VISQ and both the presence and severity of AVH. Following Langdon et al. (2011), we hypothesized that the presence of AVH would be associated with lower levels of Dialogic Inner Speech than controls, and that there would be a negative relation between AVH severity and Dialogic Inner Speech. Although this latter hypothesis was not supported by the study of de Sousa et al. (2016), it was possible that this was because the measure of hallucinations employed by their study was not specific to AVH. Finally, again following de Sousa et al., we did not hypothesize an association between the Condensed Inner Speech subscale of the VISQ and either the presence or severity of AVH.

Going beyond previous research, we also tested for associations between the inner speech of participants with AVH and their ability to dialogue with, and relate to, their voices. Research has shown that it is common for voice-hearers to experience multiple voices in dialogue, often in the voice of others, with voice-hearers' own voice distinct in this dialogue (Nayani and David, 1996; Sommer et al., 2010; McCarthy-Jones et al., 2014; Gregory, 2015; Rosen et al., 2015).

AVH are also often experienced as having distinct identities with unique characteristics (*i.e.* gender, age, personality traits) and a relational quality that can change over time (Woods et al., 2015; Rosen et al., 2015). Adding to these complexities, qualitative studies have shown a distinct voice-to-voice dialogue with unique relational and interpersonal qualities (Rosen et al., 2015). Often AVH can be identified as someone who is familiar, and are typically experienced as a voice that is separate and distinct from self (Stephane et al., 2003; Laroi, 2006; Gregory, 2015; Rosen et al., 2015). We hypothesized that alterations to specific aspects of inner speech would be associated with person's ability to form a relation both with their voices and between their voices. For example, increased levels of dialogic inner speech were hypothesized to be associated with improved relations of both persons with their voices, as well as between their voices.

In addition to testing for relations between inner speech and AVH we also explored relations between inner speech and delusions. Similar to AVH, delusions are found transdiagnostically, and they often co-occur with AVH (Rosen et al., 2016). Delusions are one of the most prominent and heterogeneous constructs associated with psychosis. The underlying mechanisms of belief formation, maintenance, and change within the delusional process have been associated with disrupted predictive processing, incorrect inference and "jumping to conclusion" bias that are weighted with heightened salience and emotional valence (Garety et al., 1991; Kapur, 2003; Kinderman and Bentall, 2006; So et al., 2016). Underlying mechanisms of cognitive control, or ability/inability to synthesize thought and action in alignment with internal goals, have also been explored (Miller and Cohen, 2001). More recently, convergent paradigms have emerged that incorporate both emotional processing symptoms and cognitive control (Underwood et al., 2015; Corlett et al., 2010). Given that delusions are associated with changes

to higher cognitive processes, including inhibitory control, and inner speech facilitates such higher cognitive processes (Alderson-Day and Fernyhough, 2015), we hypothesized that changes to inner speech contribute to delusion formation or maintenance.

Despite such a potential link, there has been very limited empirical research into the relation between inner speech and delusions. The study of de Sousa et al. (2016), discussed above, found that the only VISQ subscale associated with the severity of delusions was Other People in Inner Speech. However, when levels of hallucinations were controlled for, this relation was no longer significant. We aimed to replicate the results of de Sousa et al by testing for associations between the severity of delusions and scores on the subscales of the VISQ.

In summary, this study had four aims. The first was to test for associations between dimensions of inner speech assessed by the VISQ and a diagnosis of psychosis. The second was to assess associations between inner speech and both the presence and severity of AVH. The third aim was to explore associations between specific aspects of inner speech with the person's ability to form a relation both with and between their voices. The final aim was to explore the relation between inner speech and the severity of delusions.

2. Methods

2.1 Participants

A total of 126 participants took part in the study. The clinical sample consisted of 89 participants, of which 61 were diagnosed with schizophrenia and 28 were diagnosed with bipolar disorder with psychosis (14 bipolar manic and 14 bipolar depressed). All participants in the clinical sample had lifetime experience of AVH, of which 80% had experienced AVH within the past week (*n*=71; 59 schizophrenia, 12 bipolar). There were also 37 non-clinical controls (NCC),

who were defined as persons who did not meet the Structured Clinical Diagnostic Interview, SCID-IV (First et al., 2002) criteria for a major psychiatric disorder. Consensus diagnoses for participants were determined by the clinical and research team using the SCID-IV, and all available collateral information. Demographic characteristics for the sample and duration of untreated psychosis (DUP) were obtained at the study evaluation per self-report. DUP was defined as the number of years between onset of psychosis and initiation of antipsychotic medication and the duration of illness was defined as the number of years between onset of illness and current age. IQ was measured using the Wechsler Test of Adult Reading (WTAR) (Wechsler, 2001).

The study was approved by the University of Illinois at Chicago Internal Review Board (IRB2012-0113) and was conducted in accordance with the latest version of the Declaration of Helsinki (General Assembly of the World Medical Association, 2014). All participants gave signed written consent. All participants were between the ages of 21-60. The clinical sample needed to meet diagnostic criteria for schizophrenia or bipolar disorder with current state psychosis. The NCC sample could not have had current or past psychiatric history. Exclusion criteria for both groups included current substance dependence, seizure disorders, current pregnancy, and neurological conditions.

2.2 Measures

2.2.1 Varieties of Inner Speech Questionnaire (VISQ; McCarthy-Jones and Fernyhough, 2011)

VISQ is the only self-report measure designed to assess experiences of inner speech that is theoretically informed by Vygotsky's theory of language development (Vygotsky, 1934/1987; McCarthy-Jones and Fernyhough, 2011). It is an 18-item measure that assesses four aspects of inner speech; dialogicality ($VISQ_{dialogic}$; "When I am talking to myself about things in my mind,

it is like I am going back and forward asking myself questions and then answering them"), evaluative and motivational characteristics ($VISQ_{evalmot}$; "I talk silently to myself telling myself not to do things"), condensation ($VISQ_{cond}$; "I think to myself in words using brief phrases and single words rather than full sentences") and presence of other people ($VISQ_{other}$; "I hear other people's actual voices in my head, saying things that they actually once said to me"). Participants rate applicability of each item using on a 6-point Likert scale, with anchors of "Certainly does not apply to me" (1) to "Certainly applies to me" (6). In the current study, internal reliability, as assessed by Cronbach's alpha, was satisfactory for all VISQ subscales, ranging 0.80 and 0.83.

2.2.2 Psychotic Symptom Rating Scales (PSYRATS; Haddock et al., 1999)

The PSYRATS consists of two sub-scales that measure dimensions of auditory verbal hallucinations (AVH) and delusions experienced within the past week. The AVH subscale (PSYRATS-AH) measures eleven characteristics of AVH; frequency, duration, location, loudness, beliefs regarding origin of voices, controllability, disruption, negative content (amount and intensity) and distress (amount and intensity). The delusions subscale (PSYRATS-D) measures six characteristics of delusions; preoccupation (amount and duration), conviction, distress (amount and intensity), and disruption to life caused by beliefs. Each dimension of these scales is scored ranging from 0 to 4. Internal reliability of PSYRATS-AH and PSYRATS-D in this study were 0.88 and 0.94 respectively.

2.2.3 DAIMON Scale (Perona-Garcelan et al., 2015).

DAIMON Scale is a 28-item questionnaire designed to measure a voice-hearer's interaction with their voices within the past week, in terms of dialogical characteristics. It has four subscales that assess the relationship of the person with the voice, the relationship of the voice with the person,

the hearer's emotional response to said relationship, and the relationship between the voices. Each item is scored on a six-point Likert scale from 0 ("I have not talked to my voices during the last week") to 5 ("I always talked to my voices in the past week"). In the current study, internal reliability of the subscales ranged from 0.84 to 0.92.

2.4 Data Analysis

All statistical analyses were conducted using SPSS version 24.0. Between group differences in demographics were analyzed using chi-squared tests and independent sample *t*-tests. The effect of clinical status (psychosis diagnosis, non-clinical population) on the four VISQ subscales was to be first assessed using multivariate analysis of variance (MANOVA). If this was significant, this was to be followed up by independent sample *t*-tests comparing the four VISQ subscales between the two groups. The effect of AVH status (experienced AVH in past week, lifetime experience of AVH but none in past week, and non-clinical) on the four VISQ subscales was first assessed using multivariate analysis of variance (MANOVA). If this was significant, this was to be followed up by conducting four ANOVAs, comparing the four VISQ subscales between the three groups. Significant differences were to be followed up by Bonferroni corrected *t*-tests. Hierarchical multiple linear regressions were used to examine the unique contribution of VISQ subscales in the prediction of PSYRATS-AH and PSYRATS-D scores. Pearson's bivariate correlations with bootstrapping at 1000 iterations were conducted to determine associations between VISQ and DAIMON subscales. As the study was already in progress when DAIMON measure was introduced to the battery of study measures, only a subsample of participants completed this measure (*n*=43; 36 schizophrenia, 7 bipolar). All participants in this subsample had experienced AVH within the past week. As this was an exploratory study, it was deemed more important to minimize Type II than Type I statistical errors, as we were concerned

not to miss associations worthy of further study. As such, no corrections to significance levels were to be made, except for post-hoc tests, where Bonferroni corrections were employed. Given this, our results were to be interpreted with caution and viewed as hypotheses for further investigation (Armstrong, 2014).

3. Results

3.1. Descriptive characteristics

Group comparisons of demographic characteristics found no significant difference between sex, race, age and IQ between the clinical and NCC groups (Table 1). The clinical group (n=89) primarily consisted of persons with current and often chronic and persistent psychotic symptoms. The mean age of onset of illness was 20 years, with a mean duration of untreated psychosis of 5 years and a mean duration of illness of 27 years.

INSERT TABLE 1 ABOUT HERE

3.2 VISQ analyses

3.2.1 Clinical and non-clinical control group comparison

MANOVA found an effect of group (clinical vs NCC) on scores on the four VISQ subscales, $F(4, 121) = 8.18$, $p < 0.001$; Wilk's $\Lambda = 0.787$, partial $\eta^2 = 0.21$. Follow-up independent sample t-tests revealed that $VISQ_{dialogic}$ scores, $VISQ_{other}$ scores, and $VISQ_{evalmot}$ were significantly higher in participants with psychosis relative to NCC, but there was no effect of group on $VISQ_{cond}$ scores (Table 1; Figure 1a).

INSERT FIGURE 1 ABOUT HERE

3.2.2 Relations with presence and severity of AVH

VISQ subscale scores were next analysed after the sample had been split into patients currently experiencing AVH ($AVH_{current}$), patients with a history of AVH but who had not experienced them in the past week ($AVH_{non\text{-}current}$) and non-clinical controls (NCC) (Table 2). Whether AVH had been experienced in the past week or not was determined by whether participants gave a non-zero or zero response to the PSYRATS-AH frequency item. MANOVA found a significant effect of group on VISQ subscale scores, $F(8, 240) = 7.16$, $p < 0.001$; Wilk's $\Lambda = 0.652$, partial $\eta^2 = 0.19$. Individual ANOVAs were performed for each VISQ subscale, with subsequent post-hoc tests performed where appropriate (Table 2).

Analysis of the significant effect of group on $VISQ_{dialogic}$ revealed, through Bonferroni corrected post-hoc tests, that the only individual group difference was that the $AVH_{current}$ group had significantly higher mean scores than those in the NCC group (Table 2; Figure 1b). Analysis of the significant effect of group on $VISQ_{evalmot}$ scores found the only significant difference between the groups was that the $AVH_{current}$ group had significantly higher means than the NCC group (Table 2; Figure 1b). Analysis of the significant effect of group on $VISQ_{other}$ scores found greater scores in the $AVH_{current}$ group compared to both the $AVH_{non\text{-}current}$ group and the NCC group (Table 2; Figure 1b). There was no effect of group on $VISQ_{cond}$ scores (Table 2; Figure 1b).

INSERT TABLE 2 ABOUT HERE

3.3 Unique associations between VISQ subscales and PSYRATS-AH and PSYRATS-D scores

As above, analyses were performed using only clinical group data (schizophrenia, *n*=61, bipolar with psychosis, *n*=24), to examine whether VISQ subscale scores uniquely predicted PSYRATS-AH and PSYRATS-D scores. There were four missing participants in this analysis as the

PSYRATS measure was introduced after the study was underway. A two-stage hierarchical multiple regression was first performed with PSYRATS-AH score as the dependent variable (Table 3). As we were postulating a relation between delusions and inner speech, we controlled for levels of delusions by entering this in the first stage of the regression. All four subscales of VISQ were entered separately in stage two. Although, as reported in the original VISQ study (McCarthy-Jones and Fernyhough, 2011), there were correlations between multiple VISQ subscales, all were within accepted limits. Thus, it was deemed that there was no evidence of multicollinearity (Hair et al., 1998; Coakes, 2005). An examination of Mahalanobis distance scores indicated no multivariate outliers. Residual and scatter plots indicated that the assumptions of normality, linearity and homoscedasticity were all satisfied (Hair et al., 1998; Pallant, 2001).

The results of the hierarchical multiple regression revealed that in the first stage, PSYRATS-D scores contributed significantly to the model ($F(1,83) = 26.64$, $p < 0.001$, $R^2 = 0.24$). The addition of the four VISQ subscales in stage two accounted for a significant further amount of variance in PSYRATS-AH scores, $\Delta F(4,79)=10.66$, $p<0.001$, $\Delta R^2=0.27$, with the overall resultant model also being significant, $F(5,79)=16.34$, $p<.001$, $R^2=0.51$. When all independent variables were included in the regression model, PSYRATS-D, $VISQ_{other}$, and $VISQ_{evalmot}$ were significant predictors of PSYRATS-AH scores, and this model accounted for 51% of the variance in PSYRATS-AH scores.

INSERT TABLE 3 ABOUT HERE

We next repeated the two-stage hierarchical multiple regression with the PSYRATS-D as the dependent variable. In Stage-one, we entered PSYRATS-AH scores and in Stage-two, we entered the four VISQ subscale scores. The hierarchical multiple regression revealed that at

stage-one, PSYRATS-AH scores contributed significantly to the regression model ($F(1,83) = 26.64$, $p \leq 0.001$, $R^2 = 0.24$). The inclusion of the four VISQ subscales in Stage-two did not account for a significant amount of further variance, $\Delta F(4,79)=1.08$, $p = 0.37$, $\Delta R^2=0.04$. However, the overall model remained significant ($F(5,79) = 6.22$, $p \leq 0.001$, $R^2 = 0.28$). When all independent variables were included in the regression model, only PSYRATS-AH scores significantly predicted PSYRATS-D scores.

3.4 Relations between VISQ and DAIMON scores

The association between VISQ and DAIMON scores were assessed in the subset of participants to whom both these measures were administered ($n = 43$; 36 schizophrenia and 7 bipolar with psychosis). All participants in this subsample endorsed experiencing AVH within the past week. As reported in Table 4, there were positive correlations between $VISQ_{dialogic}$ and the relationship of person with voice; relationship of voice with person; emotional response; and the relationship between voices. Likewise, there was a positive correlation between $VISQ_{other}$ and the relationship of person with voice; relationship of voice with person; emotional response, and the relationship between voices. There was a positive relationship between $VISQ_{evalmot}$ and relationship of person with voice, and the emotional responses but there was no relationship between this variable and the relationship of voice with person, or the relationship between voices. Lastly, there was no association between $VISQ_{cond}$ and relationship of person with the voice, relationship of voice with person, emotional response, and relationship between voices. If we had employed a Bonferroni corrected alpha to these correlational analyses (adjusted $p = 0.003$) only the relationship between $VISQ_{dialogic}$ and the relationship of the voice with the person would have remained statistically significant.

INSERT TABLE 4 ABOUT HERE

4. Discussion

This study examined associations between inner speech and psychosis, including its specific symptoms of AVH and delusions. We also examined the relation between inner speech in persons diagnosed with psychosis and the manner in which they interacted with their voices (as well as how their voices interacted with each other).

4.1. Dialogic inner speech

Unlike de Sousa et al. (2016), we found higher levels of dialogic inner speech in persons with psychosis compared to non-clinical controls. This could be explained by the different sample compositions of our two studies. The majority of persons (80%) with psychosis in our study had current AVH. It is not clear whether this proportion was as high in de Sousa et al.'s study. Given that we found patients with current AVH (but not those with lifetime experience of AVH but none in the past week) had greater levels of dialogic inner speech than NCC, it is possible that a greater proportion of patients with current AVH in our sample led to high levels of dialogic inner speech in our sample of people with psychosis. However, although we found current AVH to be associated with elevated levels of dialogic inner speech compared to non-clinical controls, our regression analyses, found no association between dialogic inner speech and the severity of AVH once delusions were controlled for, questioning whether there was a specific relation between AVH and dialogic inner speech.

An important finding of our study was that participants with greater levels of dialogic inner speech had better relations both with their voices and between their voices. Whilst the former finding would have survived a Bonferroni correction to alpha for multiple testing, the latter would not. Nevertheless, both remain worthy of further investigation. Should these

relations be replicable and also be found to represent a casual relation, it is unclear what direction the effect would go in. It is possible that having greater levels of dialogic inner speech enables one to better interact with entities, such as voices, which enter the inner world. Alternatively, it could be that voices encourage people to undertake more dialogic inner speech. While more research is needed to assess this, it at least raises tantalizing possibility that helping people develop their dialogic inner speech could help them better cope with their voices.

4.2. Condensed inner speech

Unlike de Sousa et al. (2016), we found no evidence of differences in levels of condensed inner speech between persons with psychosis and non-clinical controls. We were hence unable to support de Sousa et al.'s contention that people with psychosis have inner speech that is predominantly condensed. Condensed inner speech also did not predict severity of voice-hearing or delusions, which was consistent with the findings of de Sousa et al. Levels of condensed inner speech also did not differ between participants with current AVH, participants with lifetime experience of AVH but no current AVH, and non-clinical controls.

Fernyhough (2004) has previously suggested two ways in which condensed inner speech could be related to AVH. In the first, a 'disruption to internalization' (DI) model, inner speech remains excessively and inappropriately expanded, with these fragments manifesting themselves when the subject is not exposed to any external speech input, leading them to be experienced as AVH. Our failure to find group differences in levels of condensed inner speech, or an association between condensed inner speech and severity of AVH, falsifies what would be predicted by the DI model. In the second potential relation, the re-expansion (RE) model, people with AVH enjoy normal, condensed inner speech under normal conditions, but under conditions of stress this comes to be expanded resulting in AVH. Our study offered some support for prediction of the

RE model that people with AVH should report comparable levels of condensed inner speech to people without AVH, but could not speak to the possibility of stress-related re-expansion to induce AVH.

4.3 Other people in inner speech

Consistent with the findings of de Sousa et al. (2016), we found that persons with psychosis had greater levels of other people in inner speech than non-clinical controls, and that the severity of AVH was positively associated with levels of other people in inner speech. We also found that those with current AVH had higher levels of other people in inner speech than both non-clinical controls and those with a history of AVH but none currently. This was to be expected, as the VISQ scale assessing levels of Other People in Inner Speech contains items directly related to AVH. de Sousa et al. (2016) argue that participants can be asked to complete the items on this VISQ subscale in relation to their inner speech specifically, rather than their voice-hearing experiences. However, due to the Other People in Inner Speech scale including questions such as "I hear other people's voices nagging me in my head", it appears likely to be hard for people to clearly and reliably distinguish between an 'inner speech' experience of this nature and an AVH. This VISQ subscale, as it stands, may not be suited to use in clinical voice-hearing populations. Additional items could be added to a revised Other People in Inner Speech scale, or additional instructions given in the preamble, to allow people to reliably report on and differentiate between others in inner speech and AVH.

A more interesting and interpretable finding was that as Other People in Inner Speech scores increased in voice-hearing patients, the better the relationship between self and voice(s) and the voice-to-voice relationship was. It is possible that individuals who already had

experience of dealing with others in their inner speech are better able to deal with AVH when they develop. However, further research will be needed to test this hypothesis.

AVH are frequently experienced as having distinct interpersonal and characterological entities or person-like identities distinct from self in which the relationship between self and their voice(s) is dynamic and changes over time (Nayani and David, 1996; Leudar et al., 1997; Garrett and Silva, 2003; Rosen et al., 2015;). Given that AVH are typically experienced as such and other people inner speech is often experienced in the clinical population, therapeutic interventions that target distressing other people inner speech, such as mindfulness-based interventions, in persons who are not comfortable dialoguing directly with voices, could prove to be an effective target in managing distressing voices (Louise et al., 2018).

4.4 Evaluative/Motivational inner speech

Unlike de Sousa et al. (2016), we found persons with psychosis to be more likely to experience increased evaluative/motivational inner speech. If further research supports this finding, it will be important to understand reasons for this and possible consequences of it. First, such increased levels of evaluative/motivational inner speech could reflect internalization of stigma associated with hallucinations and psychosis (Ando et al., 2011). Similarly, it could reflect low levels of self-esteem, which are also associated with psychosis (Hall and Tarrier, 2003).

As our regression analyses found that levels of evaluative/motivational inner speech predicted severity of AVH, it could be that inner speech plays a causal role in driving evaluative content of AVH. For example, when inner speech is positive or compassionate, AVH may be more likely to reflect this evaluative content. Likewise, there could be a similar mirror relation between negative inner speech and content of negative AVH. This is consistent with preliminary evidence that compassionate focused therapy (CFT), which works to develop more

compassionate inner speech, may be able to change content from malevolent or persecutory to more positive and reassuring AVH (Mayhew and Gilbert, 2008). However, it is also possible that AVH with negative evaluative content lead to the hearer developing negative inner speech (Nayani and David, 1996; McCarthy-Jones et al., 2014). These are interesting and clinically important questions for further research to address.

4.5 The intersection between inner speech, AVH and delusions

Distinctions between inner speech and AVH occur at the point of loss of authorship, or "mineness" by which the voice-hearer begins to give meaning to the voice, which can contribute to the formation of delusional content (Deamer and Wilkinson, 2015; Waters and Jardri, 2015; Bell et al., 2017). Voices are a complex and extremely heterogeneous phenomenon that one may attribute to spiritual entities, aliens or as being similar to known people (alive or deceased) (Rosen et al., 2015; Jones and Luhrmann, 2015). Additionally, more recent emphasis is being placed on the interpersonal relationship between self and the voices. Voices that that have been described as having 'a mind of their own' or a distinct personality with rich and complex attributes, a developed interactive personification and social agent (Wilkinson and Bell, 2016; Humpston, 2017). This suggests that the experience is such that it is distinct from self and at times extreme and completely unfamiliar in that the only understanding that makes sense would be something otherworldly or at the extreme edge of possibilities. As our data show, participants with current AVH were more likely to experience a labyrinth of tangled dialogic, other people, and evaluative motivational inner speech. Although the co-existence of AVH and delusions is highly prevalent, when we examined predictive power of specific types of inner speech to identify presence and severity of delusions, after controlling for AVH, no specific type of inner speech predicted presence and severity of delusions. However, that is not to say that the relation

is not intertwined, it may be that the voices and the delusions are so tightly intertwined that the experience becomes indistinguishable. Additional research in a sample of persons experiencing delusions in the absence of AVH would be required to further unpack the distinctions and nuances in the relationship between delusions and types of inner speech.

4.6 Inner speech, AVH, delusions and clinical implications

Clinically, this studies' findings underscore the need for greater attention to nuances and interaction between inner speech, AVH and delusions. Typically, while antipsychotic medication and/or cognitive behavioral therapy for psychosis (CBTp) are recommended first-line treatments for hallucinations and/or delusions, they are not always effective (Lehman et al., 2004; National Collaborating Centre for Mental Health, 2014). There is much emphasis in clinical intervention literature regarding significance of targeting relationship between self and voices to decrease distress and improve functional outcome (Thomas et al., 2014). Our data would be consistent with the hypothesis that the relationship between inner speech, voices and delusions is engaging, interactive and dynamic, potentially mirroring or reflecting the structure and meaning given to the experience. For example, previous research has shown that psychotherapeutic interventions with compassion-focused approaches in working with persons who are experiencing AVH can also reduce psychoticism and paranoid delusions, again highlighting interconnections and/or extensions by which inner speech, AVH and delusions make contact (Mayhew and Gilbert, 2008; Leaviss and Uttley, 2015). Our data also suggests the importance of exploring therapeutic benefits of clinical interventions that support engagement or relating with voices, consistent with previous research showing that relating therapy can decrease level of distress experienced (Hayward et al., 2017). Dialogical engagement with AVH, which allows one to shape the relationship with voice(s) by acceptance, listening, and exploring meaning and positive intention

of voices can result in increased self-esteem and social function (Davies et al., 1999; Ellerby, 2016; Jones et al., 2016; Longden et al., 2017). If inner speech, AVH and delusions are at times intertwined, as we have shown, clinical interventions that include a detailed, phenomenological evaluation of inner speech, AVH and delusions rather than experiences that exist without influence of inner speech, may help to develop tailored multipronged clinical interventions that target the point of convergence and distinction.

4.7. Limitations

A first limitation of this study was that we relied on a questionnaire self-report measure of inner speech. It is possible that this may not have reflected participants' actual experiences of inner speech. There is hence need to attempt replication of our findings using more ecologically valid methods of assessing inner speech such as forms of experience sampling (Alderson-Day and Fernyhough, 2015; Heavey and Hurlburt, 2008). We also only had a modest number of participants in our sample, which will have limited the power of our analyses. This was particularly the case for our comparisons involving persons with a history of AVH but who had not experienced them in the past week. Better powered study of this is needed, in order to assess the associations of inner speech with state and trait AVH. This was a cross sectional exploratory study and cannot directly address the causal or mechanistic role of inner speech in development of AVH and/or delusions. An additional limitation of the study is that there was no association of inner speech with outcome or other confounds including other forms of symptoms or social function. Lastly, there are limitations to generalizability of these results in terms of cultural influence, such as race/ethnicity or gender identity, of subjective experience (Luhrmann et al., 2015). Nevertheless, we believe that this study provides relevant results that contribute to the

interrelatedness of inner speech, AVH and delusion, and provide fruitful hypotheses for future research to address.

5. Conclusion

These novel findings suggest a multifaceted interaction between inner speech and experience of hearing voices and experience of delusions. As this study has demonstrated, inner speech, hearing voices and delusions are not encapsulated singular experiences, but rather encompass a wider range of experiential modalities and psychological processes of interrelated features that profoundly transform one's experience. An experience that involves a disruption of the inner connectedness of inner speech or thoughts that are no longer experienced as self-generated but as having foreign agency to which meaning is given. The findings reported here could form the basis for multiple hypotheses worthy of future testing to better understand the intersections between inner speech, AVH and delusions and the experimental and clinical implications of these tangled roots. Similar to Yayoi Kusama's experiential artwork, '*Infinity Mirror,'* in which the object of distinction is lost in "self-obliteration" or in her work, or *The Souls of Millions of Light Years Away*,' in which self disappears into the landscape of lights, the contours of inner speech, voices and delusions appear to become indistinguishable at times. This complex entanglement underscores the need for expanded phenomenological and clinical research into the interrelatedness of inner speech, voices and delusions, which examine the complexities involved in disentangling this network of inner experience.

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Table 1: Demographic and clinical characteristics of sample (*n*=126)

	Clinical Sample (*n*=89)		Non-clinical Sample (*n*=37)		Group difference
Sex					$\chi^2(1)=0.38$, $p=0.85$
Male	44 (49%)		19 (51%)		
Female	45 (51%)		18 (49%)		
Race					$\chi^2(3)=8.53$, $p=0.04$
African American	70 (78%)		26 (70%)		
Asian	0		3 (8%)		
Caucasian	13 (15%)		7 (19%)		
Hispanic	6 (7%)		1 (3%)		
	Mean	SD	Mean	SD	
Age	47.12	10.76	44.43	14.06	$t_{124} = -1.16$, $p = 0.25$
IQ	91.42	11.05	95.88	14.27	$t_{108} = 1.76$, $p = 0.08$
Age at onset of illness	20.23	7.30	-	-	
Duration of untreated psychosis	5.27	8.23	-	-	
Duration of illness	26.74	13.12	-	-	
Varieties of Inner Speech Questionnaire					
Dialogic	18.31	5.68	14.73	6.35	$t_{124} = 3.12$, $p=0.002$, Cohen's $d = 0.75$
Condensed	16.45	5.41	15.73	6.02	$t_{124} = 0.66$, $p=0.51$, Cohen's $d = 0.13$
Other People	17.94	8.48	9.19	6.44	$t_{124} = 5.63$, $p<0.001$, Cohen's $d = 1.42$
Evaluative/Motivational	19.30	5.43	16.22	6.14	$t_{124} = 2.80$, $p=0.006$, Cohen's $d = 0.55$

Note. SD = Standard deviation. Age, age at onset, duration of untreated psychosis and duration of illness are all given in years.

Table 2

Mean (standard deviations) of VISQ subscale scores by participants' AVH status

VISQ subscale	$AVH_{current}$ (n=71)	$AVH_{non\text{-}current}$ (n=18)	Non-clinical control (NCC; n=37)	Effect of group $F(2,123)$	Significant group differences* (Cohen's d)
Dialogic	19.01 (5.06)	15.56 (7.18)	14.73 (6.34)	7.58, p=0.001	$AVH_{current}$ > NCC, d=0.56
Condensed	16.75 (5.34)	15.28 (5.67)	15.73 (6.02)	0.71, p=0.49	-
Other People	19.66 (8.22)	11.17 (5.78)	9.19 (6.44)	27.54, p<0.001	$AVH_{current}$ > NCC, d=1.42 $AVH_{current}$ > $AVH_{non\text{-}current}$, d=1.19
Evaluative/Motivational	19.44 (5.55)	18.78 (5.05)	16.22 (6.14)	3.92, p=0.02	$AVH_{current}$ > NCC, d=0.55

Note. $AVH_{current}$ = AVH experienced in past week. $AVH_{non\text{-}current}$ = AVH experienced, but not in the past week. VISQ = Varieties of Inner Speech Questionnaire.
* After Bonferroni correction to alpha for multiple testing.

Table 3

Regression analyses predicting PSYRATS-AH scores (*n*=85)

Step	**Variables entered**	***B***	***SE***	**β**	***t***	***p***	***VIF***
1	Delusions	1.147	0.222	0.493	5.161	<0.001	1.000
2	Delusions	0.845	0.195	0.363	4.340	<0.001	1.125
	$VISQ_{dialogic}$	0.476	0.293	0.231	1.623	0.109	2.260
	$VISQ_{condensed}$	-0.243	0.172	-0.118	-1.415	0.161	1.126
	$VISQ_{other}$	0.720	0.131	0.552	5.501	<0.001	1.621
	$VISQ_{evalmot}$	-0.785	0.268	-0.392	-2.923	0.005	2.882

Note. $VISQ_{dialogic}$ = Dialogic inner speech VISQ subscale. $VISQ_{condensed}$ = Condensed inner speech VISQ subscale. $VISQ_{other}$ = Other people in inner speech VISQ subscale. $VISQ_{evalmot}$ = Evaluative and motivational inner speech VISQ subscale.

Table 4

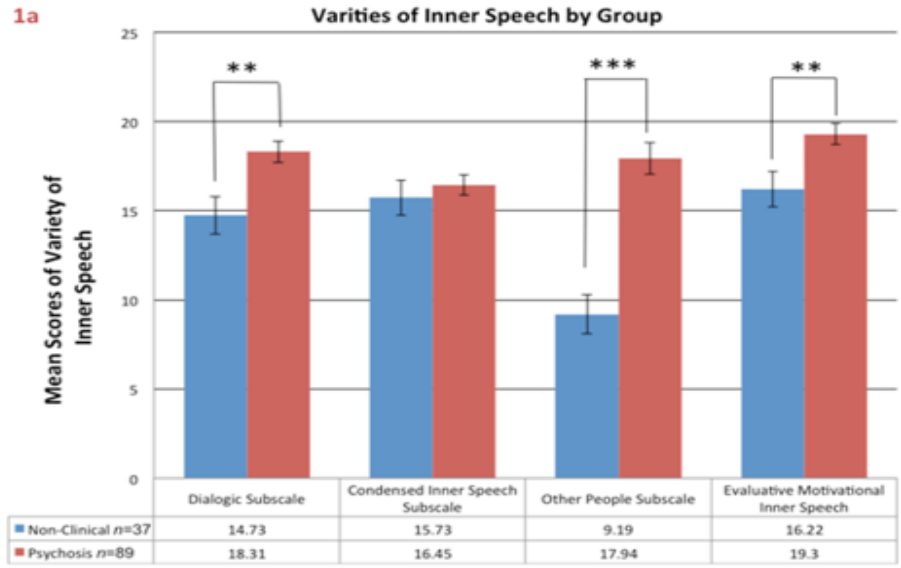
Pearson's r correlations (95% confidence intervals) between DAIMON and VISQ subscales (*n*=43)

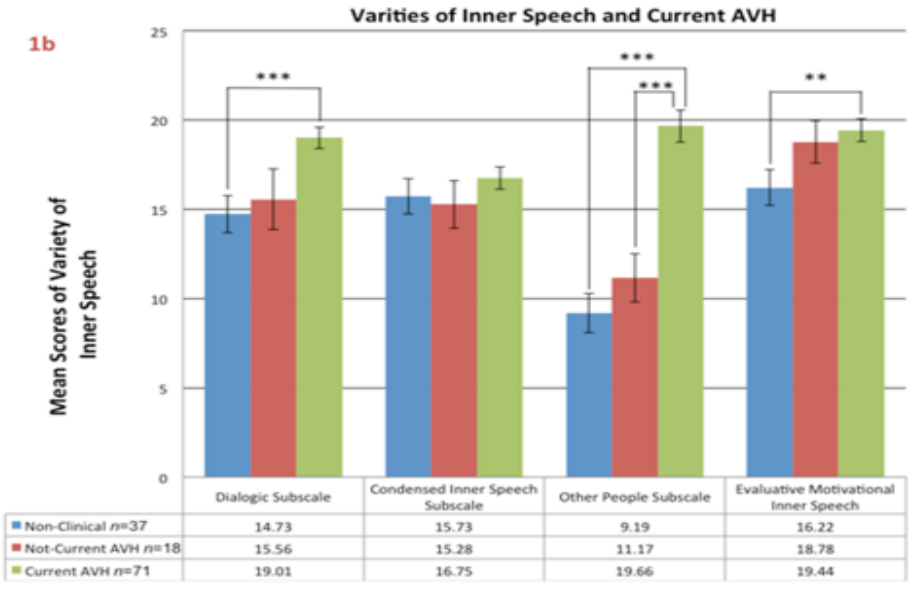
DAIMON subscale	$VISQ_{dialogic}$	$VISQ_{condensed}$	$VISQ_{other}$	$VISQ_{evalmot}$
Relationship of person with voice	0.465 [0.215, 0.640] *p* = 0.002	0.192 [-0.151, 0.474] *p* = 0.22	0.393 [0.078, 0.618] *p* = 0.009	0.311 [0.012, 0.515] *p* = 0.04
Relationship of voice with person	0.336 [0.054, 0.640] *p* = 0.03	0.174 [-0.112, 0.439] *p* = 0.26	0.367 [0.010, 0.629] *p* = 0.02	0.203 [-0.201, 0.483] *p* = 0.19
Emotional response	0.335 [-0.063, 0.663] *p* = 0.03	0.169 [-0.130, 0.444] *p* = 0.28	0.423 [0.101, 0.685] *p* = 0.005	0.313 [-0.088, 0.598] *p* = 0.04
Relationship between voices	0.355 [0.014, 0.653] *p* = 0.02	0.103 [-0.257, 0.432] *p* = 0.51	0.335 [-0.006, 0.608] *p* = 0.03	0.117 [-0.302, 0.431] *p* = 0.46

Note. Confidence intervals calculated using 1,000 bootstrapped samples.

Figure 1

VISQ subscales by diagnosis in full sample (*n*=126 (1a)) and in subsets of participants with current AVH (*n*=71 (1b))





*$p \leq 0.05$. **$p \leq 0.01$. ***$p \leq 0.001$.