THE RELATIONSHIP BETWEEN SELF-AWARENESS AND PSYCHOTIC-LIKE EXPERIENCES

by

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Abstract

The psychosis phenotype is thought to exist on a continuum, such that the same symptoms experienced by individuals diagnosed with psychotic disorders can also manifest in the general population to a less severe degree. The subclinical psychotic-like experiences reported by healthy individuals share a number of risk factors with psychotic disorders and confer greater risk of developing a psychotic disorder. Thus, healthy individuals with psychotic-like experiences comprise a valid population in which to study the underlying mechanisms of clinically significant psychotic symptoms. In this thesis, we aimed to further our understanding of psychotic-like experiences and the individuals who report them. We explored the relationships between tasks measuring different aspects of self-awareness and self-reported psychotic-like experiences using data obtained from 30 university students. We found that greater sensitivity to the difference between one's own voice and another person's voice predicted fewer symptoms of persecutory ideation. Additionally, we found that greater tendency to misattribute one's own voice to an external source predicted greater symptoms of persecutory ideation.

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Chapter 1

Introduction

Schizophrenia and other psychotic disorders are costly illnesses that not only impact individuals, but also their families and wider communities (Rössler, Salize, van Os, & Riecher-Rössler, 2005). At the individual level, these disorders are associated with distressing symptoms, disability, societal stigma, and reduced life expectancy. Family members spend time, effort, and financial resources caring for the affected individual, often at the expense of their own mental and physical health. Furthermore, psychotic disorders impact national economies, as they are some of the most expensive mental illnesses in terms of cost per patient. Thus, although relatively infrequent, psychotic disorders are burdensome at both the individual and societal levels.

The Continuum of Psychosis

Despite the distinction between illness and health made by professionals in clinical practice, disease generally exists in the population on a continuum of severity, rather than a dichotomous phenomenon (Johns & van Os, 2001; Rose & Barker, 1978). The psychosis phenotype is thought to exist on such a continuum, implying that the same symptoms experienced by individuals diagnosed with psychotic disorders also can manifest in the general population to a less severe degree (Johns & van Os, 2001). The subclinical manifestation of the psychosis phenotype is often referred to in the literature as “at risk mental states,” “psychosis-proneness,” or “psychotic-like experiences.”

The prevalence of psychotic-like experiences exceeds that of psychotic disorders (Kendler, Gallagher, Abelson, & Kessler, 1996). In fact, a meta-analysis of 47 articles published between 1977 and 2007 found that the median prevalence rate of clinically significant psychotic experiences was about 1.5%, and the median prevalence rate for psychotic-like experiences, below the threshold of clinical significance, was approximately 5% (van Os, Linscott, Myin-Germeys, Delespaul, & Krabbendam, 2009). Furthermore, the median prevalence of psychotic-like experiences in children (ages 9-12 years), adolescents (13-18 years), and adults is 17%, 7.5%, and 5%, respectively (Kelleher, Connor, Clarke, Devlin, Harley, & Cannon, 2012; van Os et al., 2009). The prevalence of these experiences between countries, however, varies greatly (Nuevo, Chatterji, Verdes, Naidoo, Arango, & Ayuso-Mateos, 2010).

Psychotic-like experiences share a number of risk factors with psychotic disorders (e.g., adverse prenatal events and substance use; Kelleher & Cannon, 2011) and confer greater risk of developing a psychotic disorder. The most common outcome of psychotic-like experiences, however, is discontinuity over time (Hanssen, Bak, Bijl, Vollebergh, & van Os, 2005). That is, psychotic-like experiences are generally transitory, and most individuals with these experiences do not proceed to develop psychotic disorders. Nevertheless, individuals with psychotic-like experiences comprise a valuable population in which to study the etiology and premorbid changes associated with psychosis without the confounding effects of medication (Kelleher & Cannon, 2011). They also represent a high-risk population that could benefit from clinical monitoring or early intervention efforts (Yung, Killackey, Nelson, & McGorry, 2009).

Multiple tools have been developed to measure psychotic-like experiences (Kline, Wilson, Ereshefsky, Denenny, Thompson, Pitts, Bussell, Reeves, & Schiffman, 2012). In this research, we use a relatively new version of the Community Assessment of Psychic

Experiences (CAPE-P15; van Os, Verdoux, & Hanssen, 1999), a brief self-report instrument intended to measure positive psychotic-like experiences in the general population.

The Psychosis Continuum and Self-Awareness

Although the current symptom-based diagnostic criteria for schizophrenia make no reference to altered self-experience, self-distortions have been recognized as a feature of the disease since the 19^{th} century (Bleuler, 1911; Kraeplin, 1896). More recent is the notion that schizophrenia is fundamentally a *self-disorder* characterized by two distortions in self-experience: diminished self-affection and hyperreflexivity (Sass & Parnas, 2003). Diminished self-affection refers to a weakened sense of existing as a unified source of awareness within one's physical body. Hyperreflexivity, on the other hand, is an exaggerated state of self-consciousness, in which aspects of the self are experienced externally. Evidence of these distortions has been found experimentally in studies that link schizophrenia and psychotic-like experiences to abnormal perceptions of the body (Peled, Ritsner, Hirschmann, Geva, & Modai., 2000; Thakkar et al., 2011) and the tendency to mistake self-generated events (e.g., one's own thoughts or inner speech) for external events (e.g., another person's voice; for review, see Ditman & Kuperberg, 2005). In the current study, we attempted to better understand the relationship between self-awareness and psychotic symptoms. As this investigation was preliminary, we focused on individuals reporting psychotic-like experiences, rather than people diagnosed with schizophrenia.

Body Awareness Research: Evidence of Diminished Self-Affection

An essential aspect of one's sense of self is the perception of one's body. On a daily basis, we see, feel, and move our body through space, and we are aware that the body is our own (Gallagher, 2000). Body ownership, the sense that the body and its parts belong to oneself, is believed to arise as an interaction between multisensory information (e.g., visual, tactile, and proprioceptive inputs) and pre-existing cognitive representations of the body (Constantini & Haggard, 2007; Tsakiris & Haggard, 2005; Tsakiris, Tajadura-Jiménez, & Costantini, 2011). As such, it is possible to induce illusions of ownership of external objects that are similar to one's body in terms of appearance, tactile percepts, and posture. In the Rubber Hand Illusion (RHI), for instance, individuals often experience ownership of an artificial hand by watching it being stroked in synchrony with their own hidden hand (Botvinick & Cohen, 1998). The experience of body ownership induced by the Rubber Hand Illusion has been measured in a number of ways, including self-report questionnaires (Longo, Schüür, Kammers, Tsakiris, & Haggard, 2008), temperature change of the real hand (Moseley, Olthof, Venema, Don, Wljers, Gallace, & Spence, 2008), and perceived proprioceptive drift of the real hand toward the rubber hand (prioprioceptive drift; Botvinik & Cohen, 1998).

Schizophrenia and psychotic-like experiences are associated with greater susceptibility to the Rubber Hand Illusion. Thakkar et al. (2011) found that individuals with schizophrenia subjectively reported a stronger feeling of ownership of the rubber hand and exhibited greater proprioceptive drift toward the rubber hand than healthy controls. Healthy individuals scoring higher on the Schizotypal Personality Questionnaire and other self-report questionnaires measuring psychotic-like experiences also have been found to subjectively report stronger experiences of ownership of the rubber hand during the illusion (Germine et al., 2012; Thakkar et al., 2011). It has been postulated that during the Rubber Hand Illusion, the external object (i.e., the rubber hand) is compared to an internal reference model of the body, which includes information about the visual, anatomical, and structural characteristics of one's body (Constantini & Haggard, 2007; Tsakiris & Haggard, 2005; Tsakiris, Carpenter, James, & Fotopoulou, 2010). If the object violates the internal reference model of one's body, the illusion will not be induced, even if synchronous visual and tactile stimulation is applied (Tsakiris et al., 2010). Thus, individuals with schizophrenia and psychotic-like experiences may be more susceptible to the Rubber Hand Illusion because they have a weaker cognitive representation of their body, enabling them to reconcile external objects as part of their own body with greater ease.

Studies employing the Rubber Hand Illusion demonstrate that the integration of multisensory information from outside of the body (exteroceptive information) is necessary to elicit the experience of body awareness (Botvinik & Cohen, 1998). However, exteroceptive and interoceptive information may converge to produce a sense of body awareness (Tsakiris, Tajadura-Jiménez, & Costantini, 2011).

Interoceptive sensitivity, the awareness of the stimuli originating from within the body, is typically assessed through performance on heartbeat detection tasks (Garfkinkel, Seth, Barrett, Suzuki, & Critchley, 2014). In these tasks, participants either count the number of times they feel their heart beating during specified time periods without checking their pulse (Heartbeat Tracking Task; Schandry, 1981) or report if their heartbeat is in synchrony with an external stimulus (Heartbeat Discrimination Task; Whitehead, Blackwell, Drescher, & Heiman, 1977). Heartbeat detection is used as a proxy for interoceptive sensitivity for pragmatic reasons—heartbeats are frequent and distinct internal events that can be easily measured (Garfkinkel et al., 2014). Tsakiris, Tajadura-Jiménez, and Costantini (2011) administered a heartbeat-tracking task and simultaneously recorded participants' heartbeats to determine heartbeat accuracy. They found that individuals with lower heartbeat tracking accuracy (i.e., lower interoceptive sensitivity) were more susceptible to the Rubber Hand Illusion, as evidenced by subjective reports of rubber hand ownership and greater proprioceptive drift toward the rubber hand. These findings indicate a relationship between interoceptive sensitivity and body ownership.

Source Misattribution Research: Evidence of Hyperreflexivity

Auditory verbal hallucinations (AVHs), which are sensory experiences that occur in the absence of external stimulation, are a common symptom of schizophrenia (APA, 1994; WHO, 1973) and also can be experienced by individuals in the general population (Sommer, Daalman, Rietkerk, Diederen, Bakkar, Wijkstra, & Boks, 2010). AVHs are understood to be internally generated thoughts or inner speech that have been mistakenly attributed to an external source (Ditman & Kuperberg, 2005). They are believed to arise from a breakdown in the system responsible for executing self-initiated actions (Frith, 1987). Typically, when we initiate an action, the intention to produce the action precedes the execution. Once the action is initiated, internal efference copies of the signals used to produce the action are generated (Jeannerod, 2003). These efference copies enable us to compare the intended outcome of our action to the actual outcome, so that we can perform any necessary error corrections. Frith (1987) suggested that AVHs arise from impairment in the ability to monitor the intention to produce actions (e.g., thoughts and inner speech) before they are generated, causing individuals to experience these actions without any apparent intention initiate them. As a result, these internal events are misidentified as being externally generated. Blakemore, Wolpert, and Frith (2002), on the other hand, propose a slightly different explanation. The sensory consequences of a self-generated action are normally attenuated because they can be predicted with efference copies. On the other hand, actions generated by others cannot be predicted and are thus, not attenuated. Blakemore et al. (2002) suggest that AVHs are the result of a faulty prediction mechanism that does not attenuate of self-generated actions, thereby causing these actions to be wrongly classified as externally generated. Thus, AVHs appear to be related to issues with source-monitoring during self-initiated actions.

Studies conducted by Johns and McGuire (1999) and Johns, Rossell, Frith, Ahmad, Hemsley, Kuipers, and McGuire (2001) are consistent with the source-monitoring account of AVHs. These studies used a real-time source-monitoring paradigm, in which healthy controls and individuals with schizophrenia read aloud words and instantaneously heard feedback of a voice through a pair of headphones. After each word, the participants had to identify the source of the voice they heard as “self,” “other,” or “unsure.” In one study, the participants received feedback of their own voice with altered pitch (Johns & McGuire, 1999). In the other study, participants received feedback of their own voice and someone else’s voice, and the pitch alteration was applied to only some of the trials (Johns et al., 2001). The pitch alteration allowed investigators to create disparity between the voice participants expected to hear and the voice they actually heard, thereby making the source of the voice more ambiguous to participants. In both studies, individuals with schizophrenia were found to erroneously identify the source of the voice more often than controls, when the voice they heard was distorted. Specifically, schizophrenia participants exhibiting AVHs were more likely than schizophrenia participants without AVHs to report that their own distorted voice belonged to someone else, as opposed to just being unsure. These studies provide evidence that source-monitoring abilities may be impaired in individuals with AVHs, as they tend to misidentify the source of their own voice, especially when the source is more ambiguous.

Individuals with AVHs also may make external misattributions when listening to distorted recordings of their own voice (i.e., in paradigms with no source-monitoring component). Allen, Johns, Fu, Broome, Vythelingum, and McGuire (2004) conducted a study comparing individuals with schizophrenia and healthy individuals, in which participants listened to pre-recorded words produced in their voice or someone else's voice. A pitch distortion was applied to some of the recordings, and the participants had to determine if the voice belonged to themselves or someone else. When listening to distorted words, the patient group with current hallucinations and delusions misidentified their own voice as belonging to someone else more often than the patient group without current hallucination and delusions and healthy controls. Using the same paradigm, Allen et al. (2006) studied healthy individuals who had completed measures of psychosis proneness and found a trend for a positive correlation between hallucination-proneness and the tendency to externally misattribute one's own distorted voice.

In sum, the psychosis phenotype is associated with the self-distortions of diminished self-affection and hyperreflexivity. Individuals with schizophrenia and psychotic-like experiences exhibit greater susceptibility to illusions of body ownership, which is linked to lower interoceptive sensitivity. Individuals with schizophrenia and psychotic-like experiences have also been found to misidentify the source of self-generated events, attributing these events externally when they are uncertain of the source.

Current Research

In this thesis, we aimed to further our understanding of psychotic-like experiences and the individuals who report these experiences. We first replicated the factor structure and the score distribution of the CAPE-P15 using a large Canadian sample (N = 1741). Second, using a smaller subsample (N = 30), we administered three tasks that potentially measure different aspects of self-awareness —body ownership, interoceptive sensitivity, and source attribution of voices—to explore directly if self-awareness is related to a non-clinical measure of psychotic-like experiences. Generally, we expected that a weaker sense of body ownership, lower interoceptive sensitivity, and a greater tendency to externally misattribute self-voice would be associated with greater scores on the CAPE-P15. However, as this was an exploratory study, we did not have any specific predictions about the strength of the relationships between the self-awareness tasks and each individual subscales of the CAPE-P15.

Chapter 2

Method

Participants

Students from Queen's University (*N* = 1741) completed the CAPE-P15 scale prior to the study as a screener. Most of the respondents (N = 1652; 94.89%) were recruited from an introductory psychology course, and 89 (5.11%) of the respondents were recruited from a Facebook group advertising paid research opportunities. The total respondent sample included 1271 (73.00%) females, 372 (21.37%) males, and 98 (5.63%) individuals who did not disclose their gender. The mean age of the respondent sample was 18.08 years: 1568 (90.06%) individuals aged 17-19 years, 82 (4.71%) individuals aged 20-29 years, and 4 (0.23%) individuals aged 30+ years. However, 87 (5.05%) individuals did not disclose their age.

We aimed to recruit a stratified sample to ensure that the full range of psychotic-like experiences would be represented. Based on the distribution of current CAPE-P15 scores of a previous study that used a university sample (Capra et al., 2015; $M_{prev.study}$=20.56, $SD_{prev.study}$=4.52), we invited individuals with current CAPE-P15 scores that fell within two standard deviations of their mean (average score range: 15-30), and two standard deviations above their mean (high score range: 31-60).

Thirty-two individuals took part in the study. The data of two participants was excluded from the analysis due to procedural error during data collection. The remaining 30 participants (25 females/5 males; M_{Age}= 18.57 years; $\text{range}_{\text{age}}$=17-22 years) were native English speakers who had resided in Southern Ontario for the majority of their lives. The participants had normal or corrected vision and no self-reported hearing, speech, or language difficulties. In terms of current CAPE-P15 scores, this subsample had a mean score of 24.20 and a standard deviation of 7.03. Twenty-four participants scored in the average range and 6 participants scored in the high range based on the distribution of Capra et al. (2015).

Other-Voice Participants for the Source Attribution Task

We recruited 22 students from a Facebook group advertising paid research opportunities at Queen's University to provide their voices for the other-voice trials of the source attribution task. The audio recordings of two participants' voices were excluded from the study, as they pronounced multiple words unclearly. The remaining 20 participants (10 female/10 male; M_{Age}= 20.9 years; $\text{range}_{\text{Age}}$=18-25 years) were native English speakers who had resided in Southern Ontario for the majority of their lives. The participants had normal or corrected vision and no self-reported hearing, speech, or language difficulties.

Stimuli and Materials

Community Assessment of Psychic Experiences-Positive Scale (CAPE-P15).

The Community Assessment of Psychic Experiences (CAPE-42) is a self-report instrument, commonly used as a measure of lifetime psychotic-like experiences in the general population (CAPE; van Os, Verdoux, & Hanssen, 1999). The original scale contains 42 items across three subscales—positive, negative, and depressive symptoms (Stefanis, Hanssen, Smirnis, Avramopoulos, Evdokimidis, Stefanis, Verdoux, & van Os, 2002). Studies examining the 20 item positive scale (CAPE-P) have found that it has a stable structure and four or five factors that are differentially related to distress, depression, and poor functioning (Armando, Nelson, Yung, Ross, Birchwood, Girardi, &

Nastro, 2010; Therman, Suvisaari, & Hultman, 2014; Wigman, Vollebergh, Jacobs, Wichers, Derom, Thiery, Raajimakers, & van Os, 2012).

While investigating the structure of the CAPE-P, Capra, Kavanagh, Hides, and Scott, (2013) found that a three-factor model performed significantly better than one, four, and five-factor models, after five items related to magical thinking, grandiosity, and paranormal beliefs were omitted. The resultant 15-item scale (CAPE-P15) includes subscales of persecutory ideation, perceptual abnormalities, and bizarre experiences. Each item is rated using a four-point scale with the anchors, 1 (never), 2 (sometimes), 3 (often), and 4 (nearly always). The total score on the CAPE-P15 can range from 15-60 (Appendix A). Capra, Kavanagh, Hides, and Scott (2015) also developed a current version of the CAPE-P15 to measure psychotic-like experiences over the past three months. This scale retained the same three-factor structure as the lifetime version.

Previous studies examining the psychometric properties of lifetime CAPE-P15 scores suggest that it is a psychometrically sound measure of psychotic-like experiences, with high internal reliability ($\alpha = .79$) and item-total correlations ranging from .35-.49 (Capra et al., 2013). The current and lifetime versions of the CAPE-P15 showed strong positive correlations (Capra et al., 2015). Although no previous studies have investigated the predictive validity of either version of the CAPE-P15, Mossaheb, Becker, Schaefer, Klier, Schloegelhofer, Papageorgiou, and Amminger (2012) examined the predictive validity of the 20-item positive dimension of the original CAPE-42, from which the CAPE-P15 items were derived. They reported that the probability of individuals being correctly classified as “ultra high-risk” for developing a psychotic disorder was 72% if they had an average score of 3.20 or higher on the positive dimension of the CAPE-42.

Additionally, the probability of individuals being correctly classified as "low risk" for developing a psychotic disorder was 68% if their average score on the positive dimension of the CAPE-42 was below 3.20.

We administered the current CAPE-P15 because it is a recent and brief measure of positive psychotic-like experiences which were the focus of this thesis. In the current study, the total current CAPE-P15 scores of the large sample ranged from 15 to 55 (M=21.36, SD=5.19). As shown in *Figure 1*, the distribution of total scores was non-normally distributed, with skewness of 1.76 (SE = .06). The descriptive statistics for each subscale and individual item can be found in *Table 1*. With the exception of items one and two, the modal response on items of the scale was "1", indicating that the majority of participants in the sample did not report having the experiences described in the CAPE-P15 within the past three months. The modal response on both items one and two was "2", indicating that the majority of participants in the sample sometimes had the experiences described in the past three months. The descriptive statistics for the subscale and total scores by gender can be found in *Table 2.* The mean scores of male participants were consistently higher than mean scores of female participants across all subscales of the CAPE-P15.

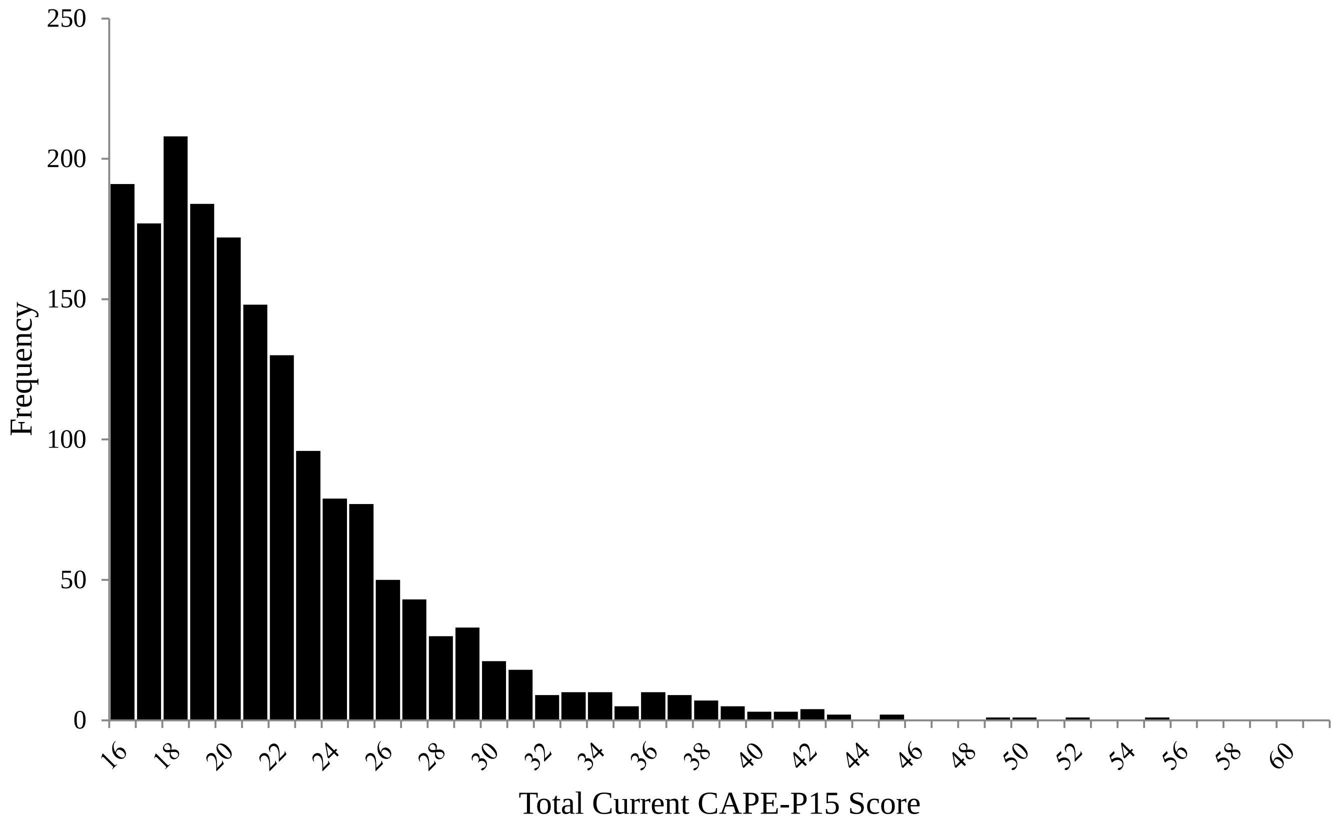

Figure 1. The Distribution of Total Current CAPE-P15 Scores

Table 1

Descriptive Statistics for Items and Subscale of the Current CAPE-P15

Item/Subscale	Minimum	Maximum	Mean	SD	Modal Response
1...felt as if people seem to drop hints about you or say things with a double meaning?	1	4	1.91	0.75	2
2...felt as if some people are not what they seem to be?	1	4	2.39	0.84	2
3...felt that you are being persecuted in anyway?	1	4	1.35	0.63	1
4...felt as if there is a conspiracy against you?	1	4	1.22	0.54	1
5...felt that people look at you oddly because of your appearance?	1	4	1.70	0.83	1
Persecutory Ideation Subscale (Range: 5-20)	5	20	8.57	2.53	-
6...felt as if electrical devices such as computers can influence the way you think?	1	4	2.05	0.99	1
7...felt as if the thoughts in your head are being taken away from you?	1	4	1.32	0.66	1
8...felt as if the thoughts in your head are not your own?	1	4	1.30	0.59	1
9...ever been so vivid that you were worried other people would hear them?	1	4	1.30	0.64	1
10...heard your thoughts being echoed back at you?	1	4	1.26	0.59	1
11...felt as if you are under the control of some force or power other than yourself?	1	4	1.20	0.55	1
12...felt as if a double has taken the place of a family member, friend or acquaintance?	1	4	1.12	0.44	1
Bizarre Experiences Subscale (Range: 7-28)	7	28	9.60	3.05	-
13...heard voices when you are alone?	1	4	1.10	0.41	1
14...heard voiced talking to each other when you are alone?	1	4	1.06	0.29	1
15...seen objects, people or animals that other people can’t see?	1	4	1.06	0.33	1
Perceptual Abnormalities Subscale (Range: 3-12)	3	12	3.22	0.85	-

Note. All items are preceded by “In the past three months, have you…”

Table 2

Descriptive Statistics for Current CAPE-P15 Subscale and Total Scores by Gender

	Male				Female			
Subscale/Total Scores	Minimum	Maximum	Mean	SD	Minimum	Maximum	Mean	SD
Persecutory Ideation Subscale (Range: 5-20)	5	18	8.66	2.57	5	20	8.55	2.52
Bizarre Experiences Subscale (Range: 7-28)	7	28	9.83	3.36	7	27	9.50	2.95
Perceptual Abnormalities Subscale (Range: 3-12)	3	12	3.33	1.11	3	12	3.19	0.75
Total Score (Range: 15-60)	15	52	21.82	5.64	15	55	21.23	5.03

We examined the factor structure previously found for the CAPE-P15 because the scale had not previously been used in a Canadian university sample like ours. We conducted confirmatory factor analyses using the lavaan package (Rosseel, 2012) for R (Version 3.3.0; R Core Team, 2016). We compared a single factor model, a three-factor model that assumed no covariance between error terms, and a three-factor model that assumed covariance between certain error terms determined by Capra et al. (2015). Good fit was indicated by Root Mean Squared Error Approximation (RMSEA) < .05, and Comparative Fit Index (CFI) and Tucker-Lewis Index (TLI) > .93.

The absolute and incremental fit indices for all three models are provided in *Table 3*. The one-factor model had poor fit to the data. The three-factor model with no error covariance paths fit the data significantly better than did the one-factor model, $\chi^2_{\text{Model A}} - \chi^2_{\text{Model B}} = 1638.90$, $df = 3$, $p < .001$, and the fit indices were in the fair to mediocre range. The three-factor model with error covariances between the following item pairs: 10/13, 12/15, 9/4. 14/4, 2/5 (Capra et al., 2015) fit the data significantly better than did the three-factor model with no error covariances, $\chi^2_{\text{Model B}} - \chi^2_{\text{Model C}} = 47.43$, $df = 5$, $p < .001$, and the fit indices were slightly better as well. Thus, the three-factor model with error covariances was the preferred model, and subsequent analyses were conducted using the three subscales.

Table 3

Fit Indices from Confirmatory Factor Analysis of current CAPE-P15

Model	RMSEA	CFI	TLI
Model A: 1-Factor Model	0.12	0.71	0.66
Model B: 3-Factor Model	0.07	0.92	0.90
[1]Model C: 3-Factor Model	0.06	0.92	0.90

Note. RMSEA= Root mean squared error of approximation, CFI= Comparative Fit Index, TLI= Tucker-Lewis Index

[1] Allowed error covariance for CAPE-P15 items 10/13, 12/15, 9/4, 14/4, 2/5.

Language Background Questionnaire

Participants completed a brief questionnaire about their language background, providing information about their parents' first language, their language(s) of instruction, and the countries/regions in which they had lived. The questionnaire was used to confirm that participants were native English speakers, who had resided in Southern Ontario for the majority of their lives (Appendix B).

Voice Stimuli for the Source Attribution Task

Pre-recorded words articulated by the study participants and other-voice participants were used as stimuli in the source attribution task.

Word Selection

We selected 85 words (Appendix C) from the MRC Psycholinguistic Database (Wilson, 1988) with the following characteristics:

- number of phonemes (3-4)
- number of syllables (1)
- word frequency (> 400 occurrences per million words, based on $\text{SUBTLEX}_{\text{US}}$ word frequency norms; Brysbaert & New, 2009)
- concreteness (≥ 390 on a scale of 100 [abstract] to 700 [concrete]; Gilhooly & Logie, 1980; Paivio, Yuille, & Madigan, 1968; Toglia & Battig, 1978)
- phonetic syllabic form C-V-C(C)

Word length, frequency, and concreteness have been found to predict word recognition speed (Juhasz & Rayner, 2003). Words with the aforementioned characteristics were chosen to ensure that other-voice and study participants would be able to recognize and read each word with speed and accuracy during the stimulus recording phase. Words with these characteristics were also chosen to minimize lexical processing during the source attribution task, so that participants could attend to the sound quality of the voices presented.

Stimulus Recording and Preparation

The recordings of each word by study participants and other voice participants were sampled at a rate of 22 kHz and stored as 16-bit sound files. The audio files were edited using Audacity (Version 2.1.1; Audacity Team, 2015) and RMS amplitude normalized using Adobe Audition CC (2015; Adobe Systems Inc.) to ensure that the average amplitudes of all the audio files were approximately matched in terms of volume.

Match Words. Each study participant was assigned the other-voice with the closest mean fundamental frequency to their own voice on five match words (burn, doll, fish, shed, wrap). The rationale for matching participants to a similar other-voice was to provide a source attribution task that was approximately equal in difficulty for all participants. Thus, in addition to gender, we chose to match voices based on fundamental frequency, a measurable voice characteristic used in voice identification (Xu, Homae, Hashimoto, & Hagiwara, 2013).

Undistorted and Distorted Stimulus Words. The edited and normalized recordings of the remaining 80 stimulus words were used in the source attribution task. Half of the stimuli remained unaltered for the undistorted trials. We lowered the pitch of the other half of the stimuli by four semitones using Audacity (Version 2.1.1; Audacity Team, 2015) for the distorted trials. All of the words were equally likely to be in either category.

Equipment

Soundproof Booth

Participants were seated in a double-walled Industrial Acoustics Company (IAC Model 1205) soundproof booth for all of the tasks in the current study.

Microphone

A Countryman E6IDP5T E6i Directional Earset Microphone was used to create audio recordings for the source attribution task. The microphone has a relatively flat frequency response from 30 to 15000 Hz and a sensitivity of 6.0 mV/Pa.

Mixer

A Mackie 1202 analog mixer was used to provide phantom power to the Countryman microphone described above. The mixer has a relatively flat frequency response between 20 Hz to 20,000 Hz and a total harmonic distortion of 0.0007%.

Digital Stethoscope

A Thinklabs One Digital Stethoscope was used in the heartbeat tracking task. The stethoscope has user-selectable audio filters that amplify sounds within a specified range. In the current study, amplified sounds in the 60-500 Hz range to detect low frequency heart sounds.

Headphones

Participants wore Sennheiser HD 265 stereo headphones during the source attribution task. The headphones have a frequency response of 10 to 25,000 Hz.

Procedure

Upon arrival at the laboratory, the participants were informed that they would be taking part in a study examining individual differences in various tasks of self-awareness. They completed a questionnaire about their language background and signed an audio release form permitting audio recordings of their voices to be made during the experiment.

The tasks described below were completed by all the participants in a partially randomized order. We pre-recorded the participants' voices for use in the source attribution task during the first session and the participants completed the source attribution task during the second session. This provided the experimenter enough time to prepare the audio recordings between sessions. The order of the other tasks was randomized for each participant across the two sessions.

Voice Recording Procedure

The study and other-voice participants were seated in front of a laptop in a soundproof booth and asked to secure a microphone to their right ear. They were instructed to clearly read aloud each of the words as they appeared on the screen. We made two recordings of each of the 85 words, which were randomly presented at different points during the recording session, in case the words were read unclearly or incorrectly. The words were each presented for 1200 ms in a randomized order using a custom DMDX script (Version 5.1.3.4; Forster, 2015).

Rubber Hand Illusion (adapted from Botvinick & Cohen, 1998)

The Rubber Hand Illusion was elicited as a measure of body ownership. During the illusion, the participants sat at a table across from the experimenter in a soundproof booth, while wearing a smock that hid both of their arms. The participants were asked to place their hands into a large custom-made box with the following dimensions: w= 84 cm, d= 27 cm, h=20 cm. Images of the experimental set-up can be found in Appendix D. The box was open from the back side, which allowed the experimenter to apply tactile stimulation to the participants' hands. Inside, the box had three compartments. The participants placed their hands into the right and left compartments and a rubber left hand was placed in the middle compartment. Through an opening at the top of the box, participants were able to see their right hand and the rubber hand; however, their left hand was hidden from their view. The box also had a lid with a metal bar that extended across the top. Attached to this bar, was a sliding marker, which was used by participants to indicate their perceived finger location during the task.

In the stimulation phases, brushstrokes were applied to each participant's hidden left hand and the rubber hand using two identical paintbrushes. In the synchronous phase, the participants saw a paintbrush touching the rubber hand at approximately the same time as the paintbrush was touching their hidden left hand at a frequency of approximately 1 Hz. During the asynchronous phase, the rubber hand was touched approximately 500 ms before the participant's hidden left hand was touched. In this case, the stimulation was also applied at a frequency of approximately 1 Hz, but the stimulation of the rubber hand and participant's left hand was out of phase by approximately 0.5 Hz. Each stimulation phase lasted two minutes and the order of the phases was counterbalanced across participants.

Before and after each stimulation phase, the lid of the box was closed and the participant moved the sliding marker with their right hand to indicate the perceived location of their left index finger. The experimenter measured the distance between the marker and the edge of the box with a measuring tape. Proprioceptive drift was calculated as the difference between the pre- and post-stimulation finger location judgments.

Heartbeat Tracking Task (adapted from Schandry, 1981)

A heartbeat tracking task was administered as a measure of interoceptive sensitivity. In the task, participants' heart sounds were recorded using a Thinklabs One digital stethoscope (Thinklabs Medical LLC, 2014). The participants were instructed to place the diaphragm of the stethoscope on their torso at approximately the fifth left intercostal space. The stethoscope was securely held in place using SuperWrap, an adjustable knitted bandage to reduce movement artifacts. Instructions for placement of the stethoscope and an image of the experimental set-up are depicted in Appendix E.

During the task, participants were seated at a laptop in a soundproof booth and asked to silently count each heartbeat they felt in their body without manually checking their pulse from the time they received an audiovisual start cue on the screen to the time they received the audiovisual stop cue. This procedure was carried out for six time intervals (2500, 3000, 3500, 4000, 4500, and 5000) presented in a randomized order with a custom DMDX script (Version 5.1.3.4; Forster, 2015). After each interval, the participants were told to verbally report the number of heartbeats that they counted. The verbal responses were recorded with a voice recorder (Sony PCM M-10).

Source Attribution Task (adapted from Allen et al., 2004)

A source attribution task was administered to obtain measures of sensitivity and response bias when determining the source of self- and other generated- events. Participants were seated at a laptop in a soundproof booth for this task. Through a pair of headphones, they listened to the four categories of voice stimuli (their own undistorted and distorted voice and another person's undistorted and distorted voice) for 20 trials each. All of the participants heard the same list of 80 words, but the assignment of words to sound category was counterbalanced across participants. The audio recordings of the 80 stimulus words were presented in a random order using a custom DMDX script and after each recording, the participants used keys labelled "Me" and "Not Me" on the keyboard to indicate the identity of the voice.

Chapter 3

Results

CAPE-P15

We conducted a one-way repeated measures analysis of variance (ANOVA) to evaluate whether there were differences between CAPE-P15 subscale scores obtained during the prescreening period and the study. There were two within-subjects factors: subscale (i.e., persecutory ideation, bizarre experiences, and perceptual abnormalities) and time of administration (i.e., screening and study). The means and standard deviations for CAPE-P15 subscale scores at each administration time are presented in *Table 4.* The results of the ANOVA indicated a nonsignificant interaction between administration time and subscale, Wilk's Λ=.96, $F(2,28)$=.62, p=.55.

Table 4

CAPE-P15 Subscale Scores Obtained During the Screening Period and the Study

Subscale	Administration Time	Mean	Standard Deviation
Persecutory Ideation Subscale	Screening	9.70	3.29
	Study	9.87	3.46
Bizarre Experiences Subscale	Screening	11.10	3.82
	Study	10.73	3.46
Perceptual Abnormalities Subscale	Screening	3.97	1.79
	Study	3.60	1.40

Rubber Hand Illusion

Proprioceptive Drift

Proprioceptive drift was calculated as the difference between the pre- and post-stimulation finger location judgments. A positive proprioceptive drift value indicated perceived drift toward the rubber hand, whereas a negative proprioceptive drift value indicated perceived drift away from the rubber hand. One-sample t-tests revealed that mean proprioceptive drift in the synchronous (M=.17, SD=1.50), $t(29)$=.63, p<.53, and asynchronous stimulation phases (M=.36, SD=1.14), $t(29)$=1.74, p=.09, was not significantly different from zero. This suggests that participants perceived no significant change in the location of their real hand after either stimulation phase.

Proprioceptive Shift

We calculated proprioceptive shift for use in subsequent analyses. *Proprioceptive shift* is the increase in proprioceptive drift when visual and tactile stimulation is in phase (i.e., synchronous condition) over and above the drift caused when visual and tactile stimulation is out of phase (i.e., asynchronous condition; Tsakiris, Tajadura-Jiménez, & Costantini, 2010). Proprioceptive shift is calculated by subtracting proprioceptive drift in the asynchronous stimulation phase from proprioceptive drift in the synchronous stimulation phase. A positive proprioceptive shift value indicates that there was greater drift when visual and tactile stimulation was correlated, whereas a negative proprioceptive shift value indicates that there was less drift when the visual and tactile stimulation was correlated. The proprioceptive shift values ranged across participants from -3.70 to 3.10 cm (M=.19, SD=1.58)

Heartbeat Tracking Task

Interoceptive sensitivity for each participant was calculated as the mean heartbeat tracking accuracy score across the six trials of the task using the formula:

$$\frac{1}{6}\Sigma\left[1-\left(\frac{\left(n\ beats_{recorded} - n\ beats_{reported}\right)}{n\ beats_{recorded}}\right)\right]$$

This formula, used in previous studies employing heartbeat tracking tasks (e.g., Tsakiris, Tajadura-Jiménez, & Costantini, 2010), yields accuracy scores between zero and one. Higher scores indicate smaller differences between the number of recorded and reported heartbeats (i.e., higher interoceptive sensitivity). The mean heartbeat tracking accuracy score of the sample ranged from .04 to .96 (M=.68, SD=.21).

Source Attribution Task

Sensitivity Index (d')

We calculated the sensitivity index (d'), from Signal Detection Theory, to quantify the participants' ability to distinguish between their own voice and another person's voice in the undistorted and distorted trials. Higher d' values indicate greater sensitivity in distinguishing between own voice and another person's voice.

One-sample t-tests revealed that mean sensitivity in the undistorted trials (M=2.11 SD=.96), $t(29)$=12.06, p<.01, and the distorted trials (M=.59, SD=.76), $t(29)$=4.30, p<.01 were significantly different from zero. This indicated that participants were able to distinguish between self- and other-voice in both undistorted and distorted trials.

A paired-samples t-test revealed that participants were better able to distinguish between the voices in the undistorted trials (M=2.11 SD=.96) than in the distorted trials (M=.59, SD=.76), $t(29)$= -8.61, p<.01. These differences remained significant with the application of the Bonferonni correction to adjust for multiple comparisons. *Tables 5 and*

6 provide the mean raw scores of each response outcome for the undistorted and distorted trials of the source attribution task.

Table 5

Mean Responses in Undistorted Trials of the Source Attribution Task

Undistorted Trials			
		Stimulus	
		Self-Voice	Other-Voice
Response	"Me"	Hits 19.30 (1.12)	False Alarms 5.70 (5.72)
	"Not Me"	Misses 0.77 (1.10)	Correct Rejections 14.23 (5.69)

Note. The means reported in this table were calculated based on 40 undistorted trials.
Standard deviations are included in the brackets.

Table 6

Mean Responses in the Distorted Trials of the Source Attribution Task

Distorted Trials			
		Stimulus	
		Self-Voice	Other-Voice
Response	"Me"	Hits 6.17 (5.65)	False Alarms 2.47 (3.00)
	"Not Me"	Misses 13.83 (5.65)	Correct Rejections 17.53 (3.00)

Note. The means reported in this table were calculated based on 40 distorted trials.
Standard deviations are included in the brackets.

Response Bias (*c*)

We calculated the response bias index (*c*), from Signal Detection Theory, to determine participants' source attribution biases in the undistorted and distorted trials. *c* is the distance between the criterion value and the neutral point, where no response is favored (Stanislaw & Todorov, 1999). Thus, a negative *c* value indicated a bias for reporting that the voice belonged to oneself, a positive *c* value indicated a bias for reporting that the voice belonged to someone else, and a *c* value of zero indicated no response bias.

One-sample t-tests revealed that mean response bias in the undistorted trials (M=-.26, SD=.49), $t(29)$=-2.92, p=.01, and the distorted trials (M=1.04, SD=.75), $t(29)$=7.61, p<.01 were significantly different from zero. This indicated that in the undistorted trials, participants were biased to report that the voices they heard belonged to themselves. Conversely, in the distorted trials, participants were biased to report that the voices they heard belonged to another person.

Self-Awareness and Psychotic-Like Experiences

To examine the relationship between body ownership, interoceptive sensitivity, source attribution, and psychotic-like experiences, we conducted a path analysis using the lavaan package (Rosseel, 2012) for R (Version 3.3.0; R Core Team, 2016). Specifically, we examined six variables from the self-awareness tasks (proprioceptive shift in the Rubber Hand Illusion, mean heartbeat tracking accuracy, undistorted voice sensitivity, distorted voice sensitivity, response bias to undistorted voices, and response bias to distorted voices) as separate predictors of the CAPE-P15 subscales (persecutory ideation, bizarre experiences, and perceptual abnormalities). *Figure 2* depicts all of the paths included in the model.

The assessment of model fit was based on one absolute fit index (Root Mean Squared Approximation; RMSEA) and two incremental fit indices (Comparative Fit Index; CFI and Tucker-Lewis Index; TLI). Good fit was indicated by RMSEA <.05, and CFI and TLI >.93. As this was a saturated model, all indices suggested perfect model fit. The error variances for each of the CAPE-P15 subscales, however, differed significantly from zero, suggesting that there was a significant amount of variance that was not accounted for by this model.

We applied a Bonferonni correction to adjust for the 18 paths included in the model and found that the majority of the relationships examined were nonsignificant (*p* values >.19; *Table 5*). However, despite the application of the conservative Bonferonni correction, two significant relationships emerged. First, sensitivity in the undistorted trials of the source attribution task was significantly related to scores on the persecutory ideation subscale (b=-4.05, t= -3.07, p<.01), implying that greater ability to distinguish between self- and other-voices predicts lower persecutory ideation. Second, response bias in the undistorted trials of the source attribution task was significantly related to scores on the persecutory ideation subscale (b= 9.26, t= 3.63, p<.001), indicating that greater tendency to externally misattribute self-generated material predicts higher persecutory ideation.

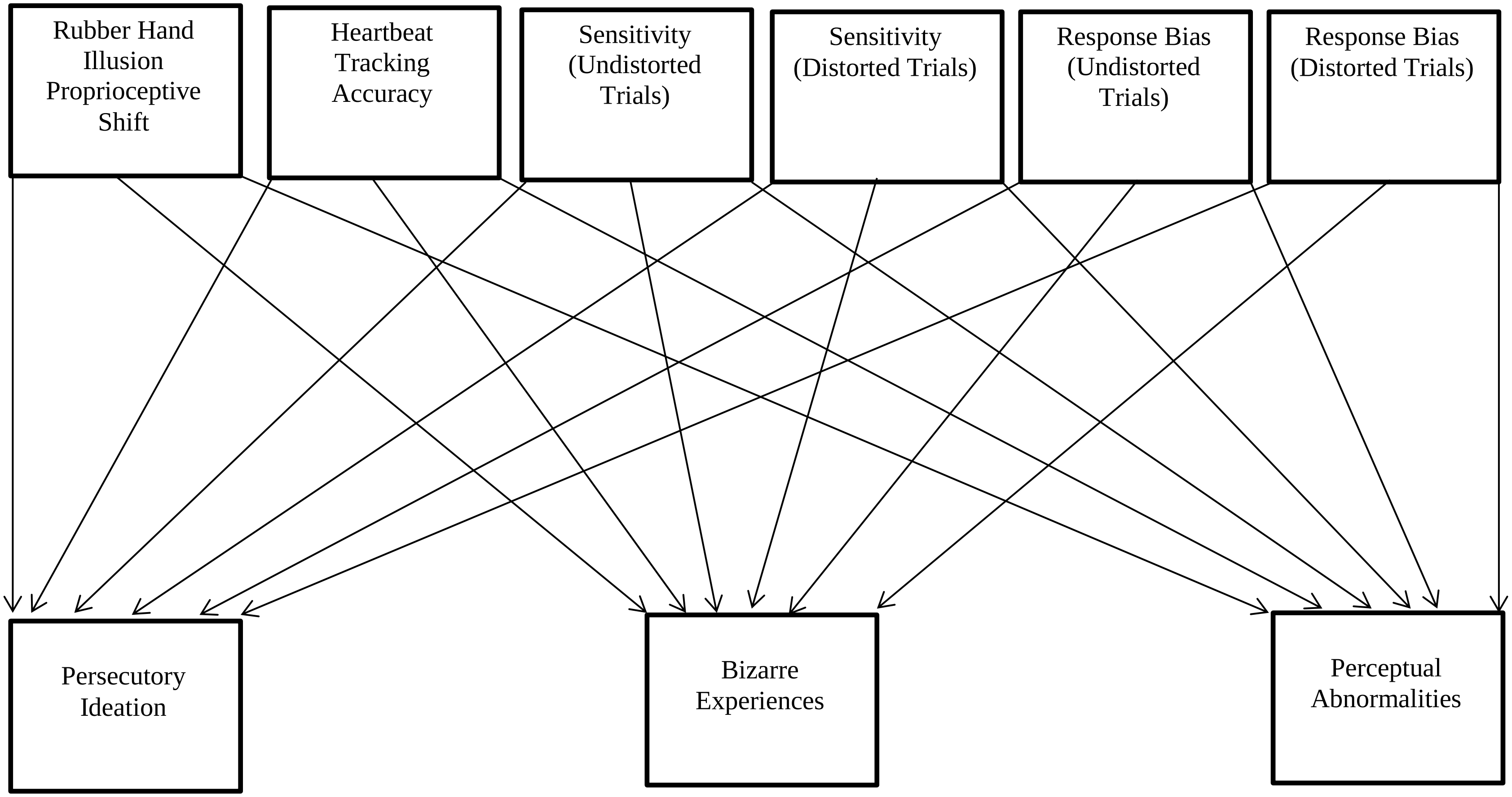

Figure 2. Path Diagram of Self-Awareness Measures as Separate Predictors of CAPE-P15 Subscale Scores

Table 7

Unstandardized Path Coefficients of Self-Awareness Measures as Separate Predictors of CAPE-P15 Subscale Scores

	Persecutory Ideation			Bizarre Experiences			Perceptual Abnormalities		
	Path Coefficient(b)	*t*	*p*	Path Coefficient (b)	*t*	*p*	Path Coefficient (b)	*t*	*p*
Rubber Hand Illusion Proprioceptive Shift	0.17	0.48	0.64	0.53	1.31	0.19	-0.03	-0.15	0.88
Heartbeat Tracking Accuracy	2.73	0.94	0.35	-1.58	-0.47	0.64	0.34	0.24	0.81
Sensitivity (Undistorted)	-4.05	-3.07	.002*	-0.26	-0.17	0.87	0.49	0.77	0.44
Sensitivity (Distorted)	-0.11	-0.13	0.9	0.87	0.86	0.39	-0.26	-0.61	0.54
Response Bias (Undistorted)	9.26	3.63	<.001*	2.17	0.74	0.46	-0.43	-0.35	0.73
Response Bias (Distorted)	0.19	0.21	0.84	-0.46	-0.43	0.67	-0.53	-1.18	0.24

Note. Significant relationships (p>.003) are denoted with an asterisks.

Chapter 4

Discussion

This thesis aimed to further our understanding of psychotic-like experiences and the individuals who report them. As a supplementary part of the thesis, we investigated the score distribution and factor structure of the current CAPE-P15 in a large Canadian university sample. In a small subsample, we subsequently examined the relationships between a set of self-awareness tasks and scores on the subscales of the CAPE-P15. For the sake of clarity, we will discuss these complementary aspects of the thesis separately.

Score Distribution and Factor Structure of the CAPE-P15

The distribution of current CAPE-P15 scores that we obtained was positively skewed, and further analysis of the responses given for each individual item revealed that positive psychotic-like experiences were infrequently reported. The distribution of scores obtained in the current study (M=21.36, SD=5.19) was similar to that of Capra et al. (2015; M=20.56, SD=4.52), suggesting that the prevalence of psychotic-like experiences is similar in Canada and Australia. In terms of the confirmatory factor analysis, the finding that the best fit was obtained by a three-factor model with error covariances between certain item pairs was consistent with the structure reported by Capra et al. (2015).

These findings contribute to the burgeoning literature on the CAPE-P15, which is a relatively recent version of the CAPE (van Os, Verdoux, & Hanssen, 1999). They indicate that the CAPE-P15 consistently measures three types of positive psychotic-like experiences: persecutory ideation, bizarre experiences, and perceptual abnormalities (Capra et al., 2013; Capra et al., 2015), even when used in different populations. A potential limitation, however, is that the current sample was primarily female. Given that the onset of schizophrenia is more common in males than it is in females between the ages of 15-25 (Leung & Psych, 2000), it is possible that psychotic-like experiences are more frequent than our study would indicate. Thus, attempts to replicate these findings in a sample with a more balanced gender ratio would be beneficial.

The majority of studies investigating the internal structure of the CAPE-P and CAPE-P15, including the current study, suggest that positive psychotic-like experiences are multidimensional. (Capra et al., 2013; Capra et al., 2015; Therman, Suvisaari, & Hultman, 2014; Wigman, et al., 2012). The multidimensional perspective implies that there are subtypes of positive psychotic-like experiences that may be associated with different levels of risk for developing psychotic disorders and other adverse mental health outcomes (Yung et al., 2009). For instance, depression symptoms were found to be weakly correlated with perceptual abnormalities (r=.35), moderately correlated with bizarre experiences (r=.44), and strongly correlated with persecutory ideation (r=.59). If multidimensional instruments measuring psychotic-like experiences are to be used as screeners for early psychosis intervention, additional research is needed to determine the predictive value of the subtypes of psychotic-like experiences.

Self-Awareness and Psychotic-Like Experiences

The main purpose of the present study was to examine the relationships between a set of self-awareness tasks and scores on a measure of psychotic-like experiences. We measured participants' sense of body ownership and interoceptive sensitivity, using the Rubber Hand Illusion and a heartbeat tracking task, respectively. We also measured participants' sensitivity in distinguishing between self- and other-generated voices, and their biases in attributing these voices to themselves or an external source. Sensitivity and response bias were measured when the source of the voices was less ambiguous (undistorted trials) and when the source of the voices was more ambiguous (distorted trials). A path analysis revealed that greater sensitivity to the difference between one's own voice and another person's voice in undistorted trials significantly predicted lower scores on the persecutory ideation subscale. Additionally, a greater tendency to misattribute one's own voice to an external source in undistorted trials significantly predicted greater scores on the persecutory ideation subscale. The other relationships examined in the path analysis were found to be nonsignificant.

The results of the present study suggest that deficits in the ability to distinguish between self- and other-generated material (i.e., own voice vs. other voice) and deficits in the ability to correctly identify the source of self-generated material may predict persecutory ideation. Interestingly, previous studies have found that individuals with delusions, including those with a persecutory theme, exhibit a "jumping-to-conclusions" reasoning bias (Colbert & Peters, 2002; Startup, Freeman, & Gerety, 2008). These individuals tend to make decisions after gathering less information than healthy controls (Gerety, Hemsley, & Wessely, 1991; Huq, Gerety, & Hemsley, 1988). Therefore, it has been proposed that a "jumping-to-conclusions" reasoning bias may be involved in the formation and maintenance of delusions (Colbert & Peters, 2002). In the context of the current study, the jumping-to-conclusions reasoning bias may provide an explanation for the observed relationships between persecutory ideation and voice attribution sensitivity and response bias, respectively. It is possible that the individuals with lower sensitivity and a greater tendency to externally misattribute their own voice also endorsed more items on the persecutory ideation subscales because they are prone to make decisions based on little information.

Although we found a few interesting relationships that warrant further investigation, the current study has clear limitations. One of the study's major limitations is its small sample size, which likely yielded unreliable parameter estimates in the path analysis due to larger standard error terms (Streiner, 2005). Thus, future attempts to replicate the current study should aim to recruit a larger sample.

The limited number of CAPE-P15 scores in the high score range is another limitation of the current study. Our sample included 24 participants with CAPE-P15 scores in the average range and only six participants with scores in the high range based on the distribution of Capra et al. (2015). Thus, it is possible that we lacked the variation in CAPE-P15 scores necessary to meaningfully explore the relationships between the aspects of self-awareness assessed in the study and psychotic-like experiences.

An additional limitation was that there were several procedural factors that may have negatively influenced the results of the Rubber Hand Illusion. First, the decision to obtain a sole behavioral measure prevented us from capturing participants' subjective experience during the illusion. We initially chose to use a behavioral measure to safeguard against problems associated with the quantification of subjective experience (e.g., suggestibility), however, obtaining both behavioral and subjective measures of the illusion could have provided information about different aspects of the illusion (Rohde, Di Luca, Ernst, 2011). Second, the finding that there was no significant difference between proprioceptive drift in the synchronous and asynchronous stimulation conditions suggests that the latter may not have been perceived as temporally asynchronous. Rohde, Di Luca, and Ernst (2011) suggested that the integration of visual and proprioceptive information (i.e., seeing a rubber hand near one's own hand) automatically induces proprioceptive drift toward the rubber hand. They found that a longer period (120 seconds) of asynchronous visual and tactile stimulation was required to break the automatic integration of visual and proprioceptive information and observe differences in proprioceptive drift between the synchronous and asynchronous condition. Although the stimulation phases in our study were also 120 seconds long, we did not observe a difference in proprioceptive drift between the asynchronous and synchronous conditions. Therefore, it is possible that asynchronous stroking in our study was not perceived temporally asynchronous enough to break the integration of visual and proprioceptive information. Third, it is possible that proprioceptive drift was reduced in the time taken by participants to move the sliding marker to indicate the perceived location of their index finger. In future attempts to induce the illusion, participants could be instructed to verbally indicate the perceived position of their index finger by reciting numbers off a ruler that is offset from between trials (e.g., Thakkar et al., 2011). Lastly, it is possible that one trial each of asynchronous and synchronous stimulation was not sufficient to assess illusion susceptibility. In the future, it may be beneficial to incorporate multiple trials of the asynchronous and synchronous condition and calculate mean drift measures for each condition.

Finally, the source attribution task in the present study may have been too difficult. When one speaks, the sound of the voice is transmitted to one's ears through air and bone conduction (Pörschmann, 2000). Thus, audio recordings of one's voice often sound unfamiliar because the low-frequency bone conducted sound has been eliminated.

In the present study, participants may have encountered difficulties when attempting to distinguish between the self and other voices because the audio recordings of their own voices sounded unfamiliar. Difficulty distinguishing between self- and other-voice may have been further exacerbated by the fact that other-voices were matched to each participant on the basis of fundamental frequency, a characteristic used in the recognition of one's own voice (Xu et al., 2013).

The current study replicated the score distribution and factor structure of the CAPE-P15. Furthermore, it provided evidence that deficits in the ability to distinguish between self- and other-generated material and the tendency to misattribute self-generated material to an external source may predict persecutory ideation. Although the other psychotic-like experiences measured by the current CAPE-P15 were not significantly predicted by the aspects of self-awareness assessed in this study, further exploration of these relationships is warranted.

Despite evidence that the psychosis phenotype is associated with disturbances in self-experience, the notion of self is rarely referenced in our understanding of these disorders (Ditman & Kuperberg, 2005; Peled et al., 2000; Thakkar et al., 2011. Sass & Parnas (2003) postulated that most symptoms of psychosis are rooted in self-disturbances. For instance, positive symptoms are the result of a deficit in the ability to identify one's own thoughts, actions, and bodily sensations as belonging to the self, thereby eliciting the feeling that these are under the control of some external force. Similarly, self-disturbances may also account for negative and disorganization symptoms. Sass & Parnas (2003) proposed that self-awareness provides a point of orientation, which enables individuals to determine the meaning and significance of information and whether it requires effortful processing (e.g., an individual who is aware that the thoughts in their head are self-produced will not need to determine the source of the thought). Individuals with self-disturbances, on the other hand, may lack this point of orientation and engage in effortful information processing. In doing so, they may exhibit negative and disorganization symptoms. Further investigation of the relationships between self-awareness and psychotic experiences could potentially provide a unified explanation of the different symptoms of psychosis and support for the notion that psychotic disorders are, in fact, fundamentally *self-disorders.*

Appendix A

Community Assessment of Psychic Experiences: Current Version (CAPE-P15)

Please circle the response option that best describes how often you have had each experience.

1. In the past three months, have you felt as if people seem to drop hints about you or say things with a double meaning?

1	2	3	4	999
Never	Sometimes	Often	Nearly Always	Uncomfortable Answering

2. In the past three months, have you felt as if some people are not what they seem to be?

1	2	3	4	999
Never	Sometimes	Often	Nearly Always	Uncomfortable Answering

3. In the past three months, have felt you that you are being persecuted in anyway?

1	2	3	4	999
Never	Sometimes	Often	Nearly Always	Uncomfortable Answering

4. In the past three months, have you felt as if there is a conspiracy against you?

1	2	3	4	999
Never	Sometimes	Often	Nearly Always	Uncomfortable Answering

5. In the past three months, have you felt that people look at you oddly because of your appearance?

1	2	3	4	999
Never	Sometimes	Often	Nearly Always	Uncomfortable Answering

6. In the past three months, have you felt as if electrical devices such as computers can influence the way you think?

1	2	3	4	999
Never	Sometimes	Often	Nearly Always	Uncomfortable Answering

7. In the past three months, have you felt as if the thoughts in your head are being taken away from you?

1	2	3	4	999
Never	Sometimes	Often	Nearly Always	Uncomfortable Answering

8. In the past three months, have you felt as if the thoughts in your head are not your own?

1	2	3	4	999
Never	Sometimes	Often	Nearly Always	Uncomfortable Answering

9. In the past three months, have your thoughts ever been so vivid that you were worried other people would hear them?

1	2	3	4	999
Never	Sometimes	Often	Nearly Always	Uncomfortable Answering

10. In the past three months, have you heard your thoughts being echoed back at you?

1	2	3	4	999
Never	Sometimes	Often	Nearly Always	Uncomfortable Answering

11. In the past three months, have you felt as if you are under the control of some force or power other than yourself?

1	2	3	4	999
Never	Sometimes	Often	Nearly Always	Uncomfortable Answering

12. In the past three months, have you felt as if a double has taken the place of a family member, friend or acquaintance?

1	2	3	4	999
Never	Sometimes	Often	Nearly Always	Uncomfortable Answering

13. In the past three months, have you heard voices when you are alone?

1	2	3	4	999
Never	Sometimes	Often	Nearly Always	Uncomfortable Answering

14. In the past three months, have you heard voices talking to each other when you are alone?

1	2	3	4	999
Never	Sometimes	Often	Nearly Always	Uncomfortable Answering

15. In the past three months, have you seen objects, people or animals that other people can’t see?

1	2	3	4	999
Never	Sometimes	Often	Nearly Always	Uncomfortable Answering

Appendix B

Language Background Questionnaire

Gender:	Age:	Handedness:
☐ Female ☐ Male		☐ Right ☐ Left

Vision:	☐ I have normal or corrected vision (e.g., glasses, contacts, etc.) ☐ I have a problem with vision
Hearing or Speech Difficulties:	☐ I do not have hearing and/or speech difficulties ☐ I have hearing and/or speech difficulties
Psyc 100:	☐ Yes, I am taking Psyc 100 ☐ No, I am not taking Psyc 100

What is your mother's first language?	What is your father's first language?
What was the primary language(s) of instruction? Elementary School: ________________________ Junior High/Middle: _______________________ High School: _____________________________	What language(s) did you speak in your household when growing up (list all)? What language(s) did you speak with your peers when growing up (list all)?

What language(s) do you speak fluently (with native proficiency)?	

Native English Speakers

What country did you live in **until the age of 10?** ☐ Canada ☐ U.S ☐ England/Ireland ☐ Australia/NZ ☐ Other (specify):________________________	What country did you live in **since the age of 10?** ☐ Canada ☐ U.S ☐ England/Ireland ☐ Australia/NZ ☐ Other (specify):________________________
What country/region did you live in **the longest?** ☐ Canada ☐ U.S ☐ England/Ireland ☐ Australia/NZ ☐ Other (specify):________________________	**For Canadian & American English Speakers:** Which province/state did you live in the longest **until the age of 18?** ____

Appendix C

Source Attribution Task Word List

Match Words

Word	Concreteness Rating	SUBTL Word Frequency	Number of Phonemes
Doll	588	1263	3
Shed	611	560	3
Wrap	457	908	3
Burn	490	2816	3
Fish	597	4258	3

Stimulus Words

Word	Concreteness Rating	SUBTL Word Frequency	Number of Phonemes
Back	540	102467	3
Beam	502	445	3
Bill	528	6041	3
Book	609	9026	3
Card	565	4357	3
Cell	542	2772	3
Chain	595	1082	4
Coin	581	497	3
Dad	603	25870	3
Deck	566	1212	3
Deed	410	475	3
Dirt	564	1310	3
Farm	565	1532	3
Feet	642	6157	3
Fell	407	3723	3

Word	Concreteness Rating	SUBTL Word Frequency	Number of Phonemes
Fog	556	482	3
Gas	554	3457	3
Guard	517	2968	3
Girl	607	28413	3
Gun	612	10873	3
Heart	605	4582	3
Hook	525	1938	3
Hot	507	4209	3
Hut	589	674	3
Jam	563	690	3
Jail	590	3602	3
Jet	580	721	3
Job	432	21063	3
Kick	485	3744	3
Kiss	564	6179	3
King	559	6592	3
Loud	413	2031	3
Lung	569	420	3
Leg	626	2882	3
Light	550	8425	3
Leak	472	517	3
Mail	508	1879	3
Meal	602	1472	3
Moon	581	2548	3
Mud	605	756	3
Net	577	793	3
Night	496	44168	3
Neck	587	3035	3

Word	Concreteness Rating	SUBTL Word Frequency	Number of Phonemes
Palm	596	675	3
Park	579	3678	3
Pearl	597	799	4
Pig	614	1996	3
Pool	573	2396	3
Rain	600	2494	3
Red	501	7551	3
Rock	600	4394	3
Rough	452	1907	3
Sack	582	659	3
Scene	408	3807	3
Sheep	622	685	3
Sign	520	6797	3
Tap	538	752	3
Thief	519	1238	3
Thin	392	1029	3
Town	556	12644	3
Van	606	2641	3
Wash	447	2077	3
Weed	600	600	3
Web	561	470	3
Wheel	573	1380	3
Wife	562	17795	3
Worm	611	516	3
Bang	435	1019	3
Bed	635	9543	3
Laugh	433	3206	3
Lip	590	548	3

Word	Concreteness Rating	SUBTL Word Frequency	Number of Phonemes
March	440	1225	4
Wood	606	1377	3
Pick	502	10118	3
Pen	571	1261	3
Room	566	22415	3
Shark	611	764	3
Shout	471	839	3
Tool	570	548	3
Tin	593	441	3

Appendix D

Images of the Rubber Hand Illusion

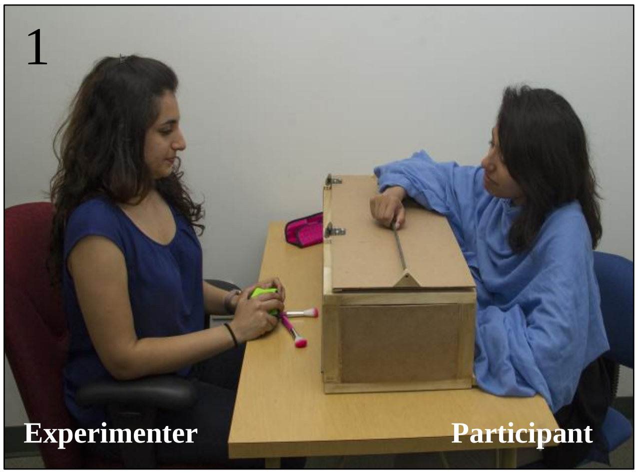

Image 1: During the illusion, participants sat at a table across from the experimenter in a soundproof booth, while wearing a smock that hid both of their arms. The participants were asked to place their hands into a large custom-made box

Before each stimulation phase, the lid of the box was closed. Participants were asked to move the sliding marker across the top of the box with their right hand to indicate the perceived location of their left index finger.

Image 2: After participants made their finger location judgment, the experimenter measured the distance between the marker and the edge of the box. This value was recorded as the pre-stimulation finger location.

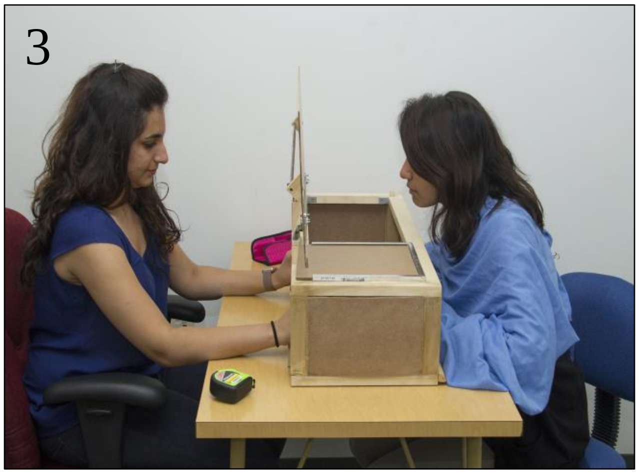

Image 3: During the stimulation phases, the lid of the box was opened. The box was open from the experimenter's side, enabling her to stroke the participant's real left hand and the rubber left hand with two identical paintbrushes.

In the synchronous phase, the brushstrokes were applied in-phase. In the asynchronous phase, the brushstrokes were applied out-of-phase.

Image 4: The participants were able to see their real right hand and the rubber left hand, but their real left hand was hidden by an opaque barrier. The barrier appears translucent in this image for illustration purposes.

Image 5: After each stimulation phase, the lid of the box was closed. Again, participants were asked to move the sliding marker across the top of the box with their right hand to indicate the perceived location of their left index finger.

Image 6: After participants made their finger location judgment, the experimenter measured the distance between the marker and the edge of the box. This value was recorded as the post-stimulation finger location.

Appendix E

Instructions for Stethoscope Placement

We will be using a stethoscope to record your heart sounds as you complete the next task. I will tell you how to place the stethoscope first and then I will leave the room, so that you can do this privately. Once you are ready, I will come back into the room and give you the instructions for the task.

Look at the mannequin in this image. I am going to tell you how to secure the stethoscope to your torso using a bandage (*point to photo of mannequin*). The stethoscope and bandage will be covered by your shirt. This photo is just an aid I use to explain the process.

I would first like you to first wrap the bandage around your torso, under your shirt. Make sure that the bandage is wrapped snugly around your body, so that the stethoscope won't move or fall out, but also make sure that you are able to sit and breathe comfortably. Once the bandage is on, tuck the stethoscope inside the bandage. The stethoscope should be placed approximately one hand span above your belly button and two inches to the left, as shown on the mannequin.

[*Provide clarification, if needed*]

Now I'm going to leave the room, so that you can place the stethoscope privately. I will knock to before I enter the room and I will check to see if your heart sounds are being recorded properly.

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