The Role of Worry, Rumination and Sleep Disturbance in Psychosis

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The aim of this thesis was to explore the relationships between worry, rumination, psychotic symptoms and sleep disturbance. The thesis is presented as three papers; a systematic literature review, an empirical study and a critical appraisal.

The systematic literature review in paper one gathered findings from clinical studies on the role of worry and rumination in psychosis. Robust evidence was found for a positive association between worry and persecutory delusions but not auditory hallucinations. Little evidence was found for a relationship between rumination and persecutory delusions or auditory hallucinations, yet conclusions remained tentative due to the limited number of studies in this area.

The empirical study in paper two used experience sampling methodology (ESM) to investigate the relationship between objective, actigraphy defined, sleep disturbance and next-day worry, rumination and psychotic symptoms in people experiencing psychosis. Sleep disturbance did not predict worry, rumination or psychotic symptoms. Worry and rumination predicted concurrent auditory hallucinations and worry additionally predicted concurrent persecutory delusions. Effect estimates were small, as was the sample size, meaning the findings must be interpreted with caution.

The critical appraisal in paper three evaluates and reflects upon the entire research process for both the literature review and empirical study. Strengths and weaknesses of the research are considered as well as implications for theory, clinical practice and future research.
Declaration

No portion of the work referred to in the thesis has been submitted in support of an application for another degree or qualification of this or any other university or other institute of learning.

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Paper One

The Role of Worry and Rumination in Psychosis: A Systematic Review

Prepared in accordance with the author guidelines of Clinical Psychology Review
The Role of Worry and Rumination in Psychosis: A Systematic Review

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Abstract

Worry and rumination are key elements of psychopathology widely investigated in depression and anxiety. Research is increasing into their role in psychosis and an association with symptom severity has been indicated. This systematic review aimed to describe current findings on the prevalence of worry and rumination in people with psychosis as well as the nature of the relationship between rumination, worry and symptoms of psychosis. The review focused on findings in the psychosis population, consequently non-clinical studies were excluded. Twenty-four studies were reviewed including assessment of their methodological quality. Results indicated that worry and rumination are highly prevalent phenomena and have a differential impact on psychotic symptoms. Robust support was found for existing models of psychosis that emphasise the positive association between worry and persecutory delusions. Sparse but consistent evidence was found that worry is not independently associated with auditory hallucinations. Far fewer studies have investigated the relationship between rumination and psychotic symptoms but those that have suggest no significant relationship with persecutory delusions and auditory hallucinations. However, more research is needed to draw stronger conclusions. Limitations of the literature and implications for future research are discussed.

Keywords: worry, rumination, psychosis, schizophrenia
Introduction

Worry and rumination are transdiagnostic phenomena associated with diverse psychological difficulties. There are several different models of worry and rumination and no single way of defining or measuring them. One of the most commonly reported definitions of rumination comes from Nolen-Hoeksema’s (1991) Response Styles Theory (RST), which was developed to explain the relationship between rumination and depression. This theory conceptualises rumination as “a mode of responding to distress that involves repetitively and passively focusing on symptoms of distress and on the possible causes and consequences of these symptoms” (Nolen-Hoeksema, Wisco & Lyubomirsky, 2008). Following an extensive review of both models and assessment of rumination, Smith and Alloy (2009) concluded that “rumination is best characterised as a stable, negative, broadly construed way of responding to discrepancies between current and status targets” (pg. 14).

Borkovec and colleagues (Borkovec, Ray & Stober, 1998) describe worry as “a predominance of negatively valenced verbal activity… most often about negative events that we are afraid might happen in the future” (p. 3). They describe the function of worry as a form of cognitive avoidance and inhibitor of emotional processing. Similarly Wells (1999) characterises worry as a predominantly verbal chain of catastrophising thoughts experienced as intrusive and uncontrollable. The Self-Regulatory Executive Function (S-REF) model views worry as a process driven by positive beliefs about its efficacy in emotion-focused coping and self-regulation (Matthews & Wells, 2004).
Not all models view worry and rumination as distinct constructs. For example, the S-REF model (Wells & Matthews, 1994, 1996) views rumination as a sub-type of worry. There is evidence to show that worry and rumination are related from studies showing they are highly correlated (Beck & Perkins, 2001; Fresco, Frankel, Mennin, Turk & Heimbery, 2002; Muris, Roelofs, Meesters & Boomsma, 2004) and share many characteristics (McLaughlin, Sibrava, Behar, & Borkovec, 2006). However, there is also evidence that there are distinctions between the two. Key differences being that worry is usually focused on threat anticipation and preparation and is future-orientated, whereas rumination is usually focused on loss, self-worth and the meaning of events and is past-orientated (Nolen-Hoeksema et al., 2008; Papagieorgiou & Wells, 1999; Watkins, Moulds & Mackintosh, 2005).

Segerstrom, Tsao, Alden & Craske (2000) argue that rumination and worry are both forms of repetitive thought and do not differentially relate to affect states. However, there is evidence contesting this conclusion. Experimental induction of worry and rumination in American university students found that worry precipitated greater anxiety, and that rumination precipitated greater depression (McLaughlin, Borkovec & Sibrava, 2006). Similarly, in a survey of Singaporean students, worry was uniquely associated with anxiety and depression whereas rumination was only associated with depression (Hong, 2007). Worry and rumination have also been shown to differentially predict coping, with worry predicting lower perceived coping effectiveness and rumination predicting disengagement from problem-solving (Hong, 2007). It has been suggested that worry and rumination are likely to involve similar processes but different content (Watkins et al., 2005).
With regard to the transdiagnostic nature of worry and rumination, meta-analyses have shown that rumination is positively associated with anxiety, depression, eating disorders and substance misuse (Aldao, Nolen-Hoeksema & Schweizer, 2010). Similarly, systematic reviews have found moderate to good quality evidence for positive associations between worry and rumination and presence of social phobia, obsessive compulsive disorder (OCD), post-traumatic stress disorder (PTSD), generalised anxiety disorder (GAD), eating disorders, sleep disorders and depression (Harvey, Watkins, Mansell & Shafran, 2004). However, the evidence for the same relationship with psychotic disorders was tentative due to the small number of studies in this area at the time.

Since the publication of the review by Harvey and colleagues (2004) there has been an increase in the number of studies investigating the role of worry and rumination in psychosis, and the evidence for a positive association between them and the presence of psychosis is growing. Specifically, dimensions of worry have been associated with dimensions of delusional ideation and psychotic experiences (Morrison & Wells, 2007). Worry is also associated with high levels of persecutory delusion distress and persistence of delusions over time (Startup, Freeman & Garety, 2007). Rumination is positively correlated with auditory hallucination distress (Badcock, Paulik & Maybery, 2011) and is related to hallucination-proneness through the mediating variable of intrusive thoughts (Jones & Fernyhough, 2009). Antecedent worry and rumination have been found to predict severity of persecutory delusions and auditory hallucinations through the mediating variable of metacognitive beliefs (Hartley, Haddock, Vasconcelos e Sa, Emsley & Barrowclough, 2013). Despite the growing evidence, no systematic
review has been conducted in this area to aggregate the evidence or evaluate its quality.

On the basis of existing evidence for the role of worry in the presence of psychosis, it has been incorporated into two different models of psychosis. Worry plays a key role in Freeman’s cognitive model of persecutory delusions (2002). This model states that, at times of significant stress, people experience an anomalous internal state which may include perceptual disturbances. They also experience anxiety which leads to anticipation of danger and interpersonal sensitivity which highlights potential threat from others. Finally, worry maintains and exacerbates the anomalous internal state as it produces more negative and implausible ideas, ultimately leading to the development of persecutory delusions.

Morrison’s cognitive model of psychosis (2001) also emphasises the role of worry in the development of psychotic symptoms. Worry is seen as an emotional and thought control strategy that gives rise to symptoms of psychosis as an unintended consequence.

Theories about the role of rumination in psychosis are more tentative. Badcock, Paulik and Maybery (2011) suggest that, as psychotic symptoms are strongly associated with increased anxiety and low mood, and that these experiences have been shown to be under the control of emotion regulation strategies, there may be a link between emotion regulation strategies and psychotic symptoms. More specifically, rumination may prolong negative affect giving more opportunity for psychotic symptoms to be triggered, or rumination may inhibit more functional problem solving and allow for implausible interpretations of events.
Recognition of the importance of worry and rumination in psychopathology has led to the development of treatments that aim to reduce worry and rumination to alleviate the associated psychopathology. A systematic review of these treatments found nineteen studies published between 2002 and 2012 that had assessed treatment of worry or rumination in participants with depression and/or anxiety (Querstret & Cropley, 2013). Studies including participants with what they termed ‘severe mental disorder’ (i.e. bipolar disorder, psychosis and serious suicidal ideation) were excluded. All the studies used mindfulness-based or cognitive behavioural interventions and findings suggested that overall these interventions were successful in significantly reducing worry and rumination. A recent randomised controlled trial (RCT) of a cognitive behaviour therapy (CBT) based worry intervention was successful in reducing worry in people with psychosis as well as reducing psychotic symptom severity; providing further evidence for a relationship between the two (Freeman et al., 2016).

As Querstret and Cropley (2013) excluded participants with psychosis from their review, no systematic review currently exists that investigates the relationship between worry, rumination and symptoms of psychosis. Elucidating the nature of the relationship between rumination, worry and psychotic symptoms could inform interventions to reduce symptoms and improve wellbeing in individuals with psychosis. Hence, this is the purpose of the current systematic review.
Aims

The objective of this systematic review was to describe current findings on the nature of the relationship between rumination and worry and symptoms of psychosis. Specific questions this review aimed to investigate include:

1. What is the prevalence of worry and rumination in the psychosis population and how does this compare to other clinical and non-clinical populations?

2. How are worry and rumination associated with symptoms of psychosis?

This review did not aim to investigate worry in the context of metacognitive beliefs about worry as this has already been explored in a recent meta-analysis (Sellers, Varese, Wells, Morrison, 2017). Therefore, studies exclusively of this nature were excluded from the current review.
Method

This review was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) methodology (Shamseer et al., 2015). The study protocol was published online on the PROSPERO database (registration number CRD42016032391).

Inclusion Criteria

Studies were included if they met the following criteria:

i. Full text written in English.

ii. Published in a peer reviewed journal between 1960 and 2016.

iii. Quantitative design.

iv. Participants had a diagnosis of a schizophrenia spectrum disorder or had symptoms consistent with this diagnosis.

v. Used a measure of rumination or worry e.g. Ruminative Response Scale (Nolen-Hoeksema, 1991) or Penn State Worry Questionnaire (Meyer, Miller, Metzger & Borkovec, 1990).

vi. Used a measure of psychotic symptoms e.g. Positive and Negative Syndrome Scale (PANSS; Kay, Opler & Fiszbein, 1986a) or Psychotic Symptoms Rating Scales (PSYRATS; Haddock, McCarron, Tarrier & Faragher, 1999).
Exclusion Criteria

Studies were excluded if they met the following criteria:

i. Case study or case series design.
ii. Review, commentary or study protocol.
iii. Participants aged under 18 years.
iv. Investigating worry or rumination in family or carers of individuals with psychosis.
v. Solely investigating worry in the context of metacognitive beliefs about worry.

Systematic Search Strategy

Eligible articles were identified using the electronic databases PsycINFO, EMBASE and Medline. Searches were conducted in November 2016 and employed the following terms: (ruminati* OR worry) AND (psychosis OR psychotic OR schizophreni* OR delusion* OR hallucination*).

Searches identified 726 articles. Titles were screened to exclude duplicates, removing 463. Titles and abstracts were screened against the inclusion and exclusion criteria, removing 203. Full texts versions of the remaining articles were obtained for screening, 36 were excluded. The remaining 24 studies were included in this review. See Figure 1 for a summary of the selection process. Ten per cent of the 263 articles were additionally screened by another author (HL) to verify adherence to the inclusion and exclusion criteria. Inter-rater reliability was high (kappa = .83, p>.005). Discrepancies were discussed between the two rating authors and a consensus was reached.
Articles identified from searches of PsycINFO, EMBASE and Medline and screened by title for duplicates

\[ n = 726 \]

Excluded \( n = 463 \)
Duplicates = 463

Title and abstract screened against inclusion and exclusion criteria

\[ n = 263 \]

Excluded \( n = 203 \)
Not a quantitative study = 51
Not English = 21
Participants inappropriate (e.g. children, non-clinical, family members) = 126
No measure of rumination/worry = 5

Full text screened against inclusion and exclusion criteria

\[ n = 60 \]

Excluded \( n = 36 \)
No measure of rumination/worry = 16
No measure of psychosis = 6
Only metacognitive = 14

Studies included in this review

\[ n = 24 \]

*Figure 1: Flow chart of study selection*
Quality Assessment

Quality of the studies was evaluated using an adapted version of the quality assessment tool for cross-sectional studies devised by Mulligan and colleagues (2016), which was based on the Newcastle-Ottawa Quality Assessment Scale for Cohort Studies (Wells et al., 2000).

The quality assessment tool evaluates studies based on the following criteria: clarity of the research aim and hypotheses, validity of the measures employed, adequacy of the description of the sampling method, adequacy of screening of psychotic symptoms, representativeness of the sample, justification of the sample size, sufficient description and reliability of the measurement of variables, appropriateness of the statistical tests and satisfactory control of confounding variables (See Appendix 1 for a full summary of the quality assessment criteria).

Studies were rated as strong, moderate or weak for each criterion according to how well the criterion was fulfilled. An overall rating of strong, moderate or weak was also given for each study. A strong overall rating was given if no criteria were rated as weak, a moderate overall rating was given if only one criterion was rated as weak and a weak rating was given if more than one criterion was rated as weak.

Ratings were made by the first author in consultation with another author (HL). Discrepancies were discussed by the two authors and a consensus was reached.
Results

Study Characteristics

Table 1 presents a summary of the twenty-four studies reviewed.

Participants. In line with inclusion criteria, participants were aged over 18 years and had a diagnosis of a schizophrenia spectrum disorder or had symptoms consistent with this diagnosis. Seven studies included a non-clinical comparison group. Two studies included a clinical comparison group. Four studies included both a clinical and non-clinical comparison group. Clinical comparison groups comprised of people with diagnoses of bipolar disorder, GAD, panic disorder, social anxiety disorder or depression.

Design. Seventeen studies employed a cross-sectional design with a survey methodology. The remaining seven studies employed a longitudinal design, of which two were RCTs; two were pilot interventions; two surveyed symptom persistence without intervention and one utilised Experience Sampling Methodology (ESM). Eighteen of the studies were conducted in the United Kingdom, five in Australia and one in Spain.

Measures. Eleven studies measured worry, five studies measured rumination and eight studies measured both worry and rumination. All but two of the studies that included a measure of worry used the Penn State Worry Questionnaire (PSWQ: Meyer et al., 1990). Morrison and Wells (2007) used the
Anxious Thoughts Inventory (AnTI; Wells, 1994). Hartley and colleagues (2013) used idiosyncratic ESM items to measure worry ‘in the moment’.

Of the studies that measured rumination, one used the Rumination-Reflection Questionnaire (RRQ; Trapnell & Campbell, 1999), three used the Response Styles Questionnaire (RSQ; Nolen-Hoeksema & Morrow, 1991), two used the Ruminative Response Scale (RRS; Treynor et al., 2003), four used the Perseverative Thinking Questionnaire (PTQ; Ehring et al., 2011) and two used the Cognitive Emotion Regulation Questionnaire (CERQ; Garnefski & Kraaij, 2007). Hartley and colleagues (2013) used idiosyncratic ESM items to measure rumination ‘in the moment’.

Eighteen studies measured psychotic symptoms using the Psychotic Symptoms Rating Scales (PSYRATS; Haddock et al., 1999) and/ or the Positive and Negative Syndrome Scale (PANSS; Kay et al., 1987). Nine studies used the Paranoid Thoughts Scale (GPTS; Green et al., 2008). The Cardiff Anomalous Perceptions Scale (CAPS; Bell, Halligan & Ellis, 2006) was used by one study, the Diagnostic Interview for Psychosis (DIP; Castle et al., 2006) by two studies, and the Brief Psychiatric Rating Scale (BPRS; Overall & Gorham, 1962) and State Social Paranoia Scale (SSPS; Freeman et al., 2007) were each used by one study.
### Table 1: Summary of reviewed studies

<table>
<thead>
<tr>
<th>Study &amp; Country</th>
<th>Sample</th>
<th>Design</th>
<th>Psychosis</th>
<th>Measures</th>
<th>Worry</th>
<th>Relevant Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Badcock et al. (2011) Australia</td>
<td>Diagnosis of SZ &amp; current AH (n=34) Non-clinical (n=34)</td>
<td>Survey</td>
<td>DIP</td>
<td>PSYRATS</td>
<td>RRS</td>
<td>PSWQ SZ group higher rumination and worry. No correlation between worry/rumination and AH severity or distress.</td>
</tr>
<tr>
<td>Bassett et al. (2009) UK</td>
<td>Current PD &amp; diagnosis of SZ, SA, DD, BD or depression with psychosis (n=25) Non-clinical (n=25)</td>
<td>Survey</td>
<td>PSYRATS</td>
<td>none</td>
<td>PSWQ</td>
<td>Worry higher in clinical group and equivalent to GAD.</td>
</tr>
<tr>
<td>Bell et al. (2011) UK</td>
<td>Current PD &amp; diagnosis of SZ, SA or DD (n=29) Non-clinical (n=193)</td>
<td>Survey</td>
<td>CAPS</td>
<td>none</td>
<td>PSWQ</td>
<td>Psychosis group worry correlated with total anomalous perceptions and each subscale (intensity, distress, frequency).</td>
</tr>
<tr>
<td>Cernis et al. (2014) UK</td>
<td>Current PD lasting &gt;3 months &amp; diagnosis of SZ, SA or DD &amp; PSWQ&gt;44 (n=50)</td>
<td>Survey</td>
<td>PANSS</td>
<td>PSYRATS</td>
<td>PTQ</td>
<td>PSWQ Positive correlation between worry and paranoid thoughts became non-significant once depersonalisation controlled for.</td>
</tr>
<tr>
<td>Cernis et al. (2016) UK</td>
<td>Current PD lasting &gt;3 months, diagnosis of SZ, SA or DD &amp; PSWQ&gt;44 (n=142) Non-clinical (n=273)</td>
<td>Survey</td>
<td>GPTS</td>
<td>PTQ</td>
<td>PSWQ</td>
<td>Rumination higher in psychosis group, equivalent to levels found in depression. Does not report PSWQ scores.</td>
</tr>
<tr>
<td>Clemente et al. (2013) Australia</td>
<td>Diagnosis of SZ &amp; history of PD &amp; not acute psychosis (n=24) Non-clinical PSWQ&gt;44 (n=25)</td>
<td>Survey</td>
<td>GPTS</td>
<td>none</td>
<td>PSWQ</td>
<td>63% of psychosis group had worry equivalent to GAD. Worry associated with delusional distress, preoccupation and conviction.</td>
</tr>
<tr>
<td>Foster et al. (2010) UK</td>
<td>Diagnosis of SZ, SA, DD &amp; current PD lasting &gt;6 months &amp; PSWQ&gt;44 (n=12 intervention, 12 control)</td>
<td>Worry intervention</td>
<td>PSYRATS</td>
<td>GPTS</td>
<td>none</td>
<td>PSWQ Intervention reduced researcher-rated PD and distress, maintained at follow up. Reduction in self-reported PD and distress not significant.</td>
</tr>
<tr>
<td>Freeman &amp; Garety (1999) UK</td>
<td>Persistent PD &amp; diagnosis of SZ or DD (n=15) Diagnosis of GAD (n=14)</td>
<td>Survey</td>
<td>BPRS</td>
<td>none</td>
<td>PSWQ</td>
<td>No difference in high level worry between groups. Worry correlated with delusional distress but not conviction or preoccupation.</td>
</tr>
<tr>
<td>Study (Year)</td>
<td>Population</td>
<td>Methods</td>
<td>Measures</td>
<td>Findings</td>
<td></td>
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<tr>
<td>Freeman et al. (2010) UK</td>
<td>Diagnosis of SZ, SA or DD &amp; current PD (n=30) High NC paranoia (n=30) Low paranoia (n=30)</td>
<td>Survey</td>
<td>GPTS SSSP</td>
<td>PSWQ All groups worry associated with paranoia but not a predictor. High NC paranoia and PD groups clinically significant level of worry.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Freeman et al. (2013) UK</td>
<td>Diagnosis of SZ, SA or DD &amp; current PD lasting &gt;3 months &amp; PSWQ&gt;44 (n=67)</td>
<td>Experimental</td>
<td>PSYRATS PANSS GPTS CAPS</td>
<td>PSWQ Worry induction: no increase in hallucinations but increase in AE. Worry reduction: reduction in AE.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Freeman et al. (2014) UK</td>
<td>Diagnosis of SZ, SA or DD &amp; current PD lasting &gt;3 months &amp; PSWQ&gt;44 (n=123)</td>
<td>Survey</td>
<td>PSYRATS PANSS GPTS PTQ</td>
<td>PSWQ High worry, close to level found in people diagnosed with GAD.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Freeman et al. (2015) UK</td>
<td>Diagnosis of SZ, SA or DD &amp; current PD lasting &gt;3 months &amp; PSWQ&gt;44 (n=150)</td>
<td>RCT worry intervention</td>
<td>PANSS PSYRATS</td>
<td>PSWQ Worry reduction intervention precipitated significant reduction in severity of worry (8.8%) and persecutory delusions (9.7%).</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Freeman et al. (2016) UK</td>
<td>Current PD lasting &gt;6 months &amp; diagnosis of SZ, SA or DD or psychosis NOS (n=12)</td>
<td>Worry intervention</td>
<td>PANSS PSYRATS</td>
<td>PSWQ CBT for worry intervention precipitated large reductions in total delusional severity and distress. Reductions in paranoid thoughts, overall psychiatric symptoms and worry.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Halari et al. (2009) UK</td>
<td>Diagnosis of SZ or SA (n=37)</td>
<td>Survey</td>
<td>PANSS RSQ</td>
<td>none Positive symptoms not associated with rumination. Negative symptoms associated with rumination.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hartley et al. (2014) UK</td>
<td>Current PD and/or AH &amp; diagnosis of SZ, SA, acute psychotic disorder or psychosis NOS (n=27)</td>
<td>ESM</td>
<td>PANSS ESM items ESM items ESM items</td>
<td>Antecedent worry and rumination predicted severity and distress of PD and AH. Negative metacognitive beliefs about worry and rumination moderated the relationship.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hepworth et al. (2011) UK</td>
<td>Diagnosis of SZ, SA or DD &amp; current PD lasting &gt;6 months (n=12)</td>
<td>Worry intervention</td>
<td>PSYRATS RSQ</td>
<td>PSWQ Pre-intervention, high levels of worry and rumination. Intervention precipitated significant reduction in delusions, associated distress and worry. Reduction in rumination did not reach significance.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Morrison &amp; Wells (2007) UK</td>
<td>Diagnosis of SZ, SA, SD (n=40) Diagnosis of PCD or SAD (n=51) Non-clinical (n=60)</td>
<td>Survey</td>
<td>PANSS PSYRATS</td>
<td>none AnTI SZ group: strong positive correlations between all worry subscales and measures of delusions but not hallucinations. No difference from anxiety disorders groups in level of worry.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Study</td>
<td>Location</td>
<td>Diagnosis</td>
<td>N (clinical)</td>
<td>N (non-clinical)</td>
<td>Survey</td>
<td>Scale</td>
</tr>
<tr>
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</tr>
<tr>
<td>Ricarte et al. (2014) Spain</td>
<td>Diagnosis of SZ (n=31) Non-clinical (n=31)</td>
<td>Survey</td>
<td>PANSS</td>
<td>RRS</td>
<td>none</td>
<td>SZ group: rumination significantly higher than controls, rumination positively correlated with negative symptoms.</td>
</tr>
<tr>
<td>Rowland, Hamilton, Lino et al. (2013) Australia</td>
<td>Diagnosis of SZ (n=126) Diagnosis of BD (n=97) Non-clinical (n=81)</td>
<td>Survey</td>
<td>DIP</td>
<td>CERQ</td>
<td>none</td>
<td>SZ group: higher levels of rumination than non-clinical but not BD, rumination not associated with positive or negative symptoms.</td>
</tr>
<tr>
<td>Rowland, Hamilton, Vella, et al. (2013) Australia</td>
<td>Diagnosis of SZ (n=56) Diagnosis of BD (n=33) Non-clinical (n=58)</td>
<td>Survey</td>
<td>PANSS</td>
<td>CERQ</td>
<td>none</td>
<td>SZ group higher levels of rumination than non-clinical but not BD.</td>
</tr>
<tr>
<td>Startup et al. (2007) UK</td>
<td>Current acute PD (n=30) Non-clinical (n=30)</td>
<td>Survey</td>
<td>PSYRATS</td>
<td>none</td>
<td>PSWQ</td>
<td>68% of PD group level of worry comparable to GAD. Worry related to delusional severity, distress, preoccupation and persistence but not conviction.</td>
</tr>
<tr>
<td>Startup et al. (2016) UK</td>
<td>Diagnosis of SZ, SA or DD &amp; current PD lasting &gt;3 months &amp; PSWQ&gt;44 (n=150)</td>
<td>Survey</td>
<td>PSYRATS GPTS</td>
<td>PTQ</td>
<td>PSWQ</td>
<td>Worry correlated with PD and rumination.</td>
</tr>
<tr>
<td>Thomas et al. (2014) Australia</td>
<td>Diagnosis of SZ (n=40)</td>
<td>Survey</td>
<td>PANSS</td>
<td>RRQ</td>
<td>none</td>
<td>Rumination levels similar to general population.</td>
</tr>
<tr>
<td>Vorontsova et al. (2013) UK</td>
<td>Current PD &amp; diagnosis of SZ, SA or DD (PD; n=30) Depression only (D; n=30) PD &amp; depression (PD+D; n=30) Non-clinical (NC; n=30)</td>
<td>Survey</td>
<td>PSYRATS GPTS</td>
<td>RSQ</td>
<td>PSWQ</td>
<td>PD+D group higher severity and distress of PD than PD group. PD+D group and D group higher rumination and worry than PD group. All clinical groups higher rumination and worry than NC group. Worry predicted persistence of paranoid thoughts.</td>
</tr>
</tbody>
</table>

**SZ** = Schizophrenia, **SA** = Schizoaffective Disorder, **DD** = Delusional Disorder, **SD** = Schizophreniform Disorder, **NOS** = Not Otherwise Specified, **BD** = Bipolar Disorder, **PCD** = Panic Disorder, **SAD** = Social Anxiety Disorder, **AH** = Auditory Hallucinations, **PD** = Persecutory Delusions, **AMD** = Awareness of presence of mental disorder, **AEM** = Awareness of the achieved effects of medication, **ASC** = Awareness of social consequences of illness, **AE** = Anomalous Experiences.
Quality Assessment Results

Table 2 presents a summary of the quality ratings for all the reviewed studies. Three studies received a strong global rating (Foster et al., 2010; Freeman et al., 2015; Hartley et al., 2013). Two studies received a weak global rating (Freeman & Garety, 1999; Morrison & Wells, 2007). All other reviewed studies received a moderate global rating.

The most common weakness shared by the studies was a lack of justification of sample size. Very few power calculations were reported making it difficult to assess the adequacy of the sample size. Many of the samples were small and potentially underpowered. Only two studies reported an a priori sample size calculation (Foster et al., 2010; Freeman et al., 2015). Hartley et al. (2013) provided justification of sample size with the explanation that power calculations cannot be carried out in the standard format for ESM studies. No other studies provided a rationale for their sample size. Moreover, three studies would have received a strong global rating rather than moderate had they included justification of sample size as all other criteria were rated as strong (Cernis et al., 2016; Freeman et al., 2010; Freeman et al., 2014).

Another common weakness was the measurement of variables. All studies provided an adequate description of the procedure for variable measurement, but only two studies reported the use of a second rater and the calculation of inter-rater reliability for researcher rated measures (Freeman et al., 2014; Halari et al., 2009). Without consideration of inter-rater reliability, the possibility of bias in these ratings cannot be ruled out.
### Table 2: Quality assessment results

<table>
<thead>
<tr>
<th>Study</th>
<th>Aim and hypotheses</th>
<th>Validity of measures</th>
<th>Sampling method</th>
<th>Adequacy of screening</th>
<th>Representativeness</th>
<th>Sample size</th>
<th>Measurement of variables</th>
<th>Statistical reporting</th>
<th>Confounding variables</th>
<th>Global rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Badcock et al. (2011)</td>
<td>M</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>W</td>
<td>M</td>
<td>S</td>
<td>S</td>
<td>M</td>
</tr>
<tr>
<td>Bassett et al. (2009)</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>W</td>
<td>M</td>
<td>S</td>
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</tr>
<tr>
<td>Bell et al. (2011)</td>
<td>M</td>
<td>S</td>
<td>M</td>
<td>S</td>
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<td>W</td>
<td>n/a</td>
<td>S</td>
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<tr>
<td>Cernis et al. (2014)</td>
<td>S</td>
<td>S</td>
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<td>S</td>
<td>S</td>
<td>W</td>
<td>M</td>
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<tr>
<td>Cernis et al. (2016)</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>W</td>
<td>n/a</td>
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<tr>
<td>Clemente et al. (2013)</td>
<td>S</td>
<td>S</td>
<td>M</td>
<td>M</td>
<td>M</td>
<td>W</td>
<td>n/a</td>
<td>S</td>
<td>S</td>
<td>M</td>
</tr>
<tr>
<td>Freeman &amp; Garety (1999)</td>
<td>S</td>
<td>M</td>
<td>M</td>
<td>W</td>
<td>M</td>
<td>W</td>
<td>M</td>
<td>S</td>
<td>S</td>
<td>W</td>
</tr>
<tr>
<td>Freeman et al. (2010)</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>W</td>
<td>n/a</td>
<td>S</td>
<td>S</td>
<td>M</td>
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<td>Freeman et al. (2013)</td>
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<td>W</td>
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<td>Freeman et al. (2014)</td>
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<td>S</td>
<td>S</td>
<td>W</td>
<td>S</td>
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<td>S</td>
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<tr>
<td>Halari et al. (2009)</td>
<td>M</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>W</td>
<td>S</td>
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<tr>
<td>Hartley et al. (2014)</td>
<td>S</td>
<td>S</td>
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<td>M</td>
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<td>M</td>
<td>S</td>
<td>S</td>
</tr>
<tr>
<td>Ricarte et al. (2014)</td>
<td>M</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>M</td>
<td>W</td>
<td>M</td>
<td>M</td>
<td>S</td>
<td>M</td>
</tr>
<tr>
<td>Startup et al. (2007)</td>
<td>S</td>
<td>M</td>
<td>M</td>
<td>S</td>
<td>M</td>
<td>W</td>
<td>M</td>
<td>S</td>
<td>S</td>
<td>M</td>
</tr>
<tr>
<td>Startup et al. (2016)</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>W</td>
<td>M</td>
<td>S</td>
<td>M</td>
<td>M</td>
</tr>
<tr>
<td>Thomas et al. (2014)</td>
<td>S</td>
<td>M</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>W</td>
<td>M</td>
<td>S</td>
<td>S</td>
<td>M</td>
</tr>
<tr>
<td>Vorontsova et al. (2013)</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>M</td>
<td>S</td>
<td>W</td>
<td>M</td>
<td>S</td>
<td>S</td>
<td>M</td>
</tr>
</tbody>
</table>

*Note: M – moderate, W – weak, S – strong, n/a – not applicable*
What is the prevalence and severity of worry and rumination in the psychosis population and how does it compare to other clinical and non-clinical populations?

Seven of the nineteen studies that measured worry specifically recruited a sample of individuals experiencing psychosis and a clinically significant level of worry by screening out those scoring 44 and below on the PSWQ (Cernis et al., 2014; Cernis et al., 2016; Foster et al., 2010; Freeman et al., 2013; Freeman et al., 2014; Freeman et al., 2015; Startup et al., 2016). Therefore, the level of worry and rumination reported by these studies is not representative of the general psychosis population.

Worry. The majority of studies defined a clinically significant level of worry as a score above 44 on the PSWQ as this is the score shown to discriminate treatment seeking individuals with a diagnosis of GAD from non-anxious controls (Behar, Alcaine, Zuelig & Borkovec, 2003). As can be seen in Table 3, of the ten studies that administered the PSWQ to a psychosis sample that had not been screened for level of worry, nine found mean levels of worry above the cut-off for clinical significance. One study did not report the mean (Bell et al., 2011).

Also shown in Table 3, four studies used the PSWQ to compare the level of worry in the psychosis population to the non-clinical population and found significantly higher levels of worry in the psychosis population. Two studies reported the percentage of participants with psychosis who scored above the cut-off for clinically significant worry. Both figures were similar with Clemente and colleagues (2013) finding 63% and Startup and colleagues (2007) finding 68%.
Table 3: Mean PSWQ score in studies with no screening for level of worry.

<table>
<thead>
<tr>
<th>Study</th>
<th>Mean PSWQ score</th>
<th>Significant difference between psychosis and NC</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Psychosis</td>
<td>NC</td>
</tr>
<tr>
<td>Badcock et al. (2011)</td>
<td>49.79</td>
<td>38.00</td>
</tr>
<tr>
<td>Bassett et al. (2009)</td>
<td>46.68</td>
<td>38.64</td>
</tr>
<tr>
<td>Bell et al. 2011</td>
<td>Not reported</td>
<td>Not reported</td>
</tr>
<tr>
<td>Clemente et al (2013)</td>
<td>50.67</td>
<td>-</td>
</tr>
<tr>
<td>Freeman &amp; Garety (1999)</td>
<td>53.90</td>
<td>-</td>
</tr>
<tr>
<td>Freeman et al. (2010)</td>
<td>58.96</td>
<td>-</td>
</tr>
<tr>
<td>Freeman et al (2016)</td>
<td>67.40</td>
<td>-</td>
</tr>
<tr>
<td>Hepworth et al. (2011)</td>
<td>62.08</td>
<td>-</td>
</tr>
<tr>
<td>Startup et al. (2007)</td>
<td>50.64</td>
<td>40.38</td>
</tr>
<tr>
<td>Vorontsova et al. (2013)</td>
<td>46.70</td>
<td>39.10</td>
</tr>
</tbody>
</table>

Three studies compared the level of worry in the psychosis population to another clinical group. Freeman and Garety (1999) found no significant difference between the level of worry reported by people with psychosis compared to those with GAD. Clemente and colleagues (2013) found people with psychosis had lower levels of worry than ‘pathological worriers’, defined as scoring above the cut-off for clinically significant worry and having no history of psychosis. Vorontsova and colleagues (2013) found people with psychosis had lower levels of worry than those with depression, but people with psychosis and depression did not differ in level of worry to those with depression only.

Overall it appears that worry is a highly prevalent psychological process in people with psychosis and is frequently severe enough to be clinically significant and comparable to the severity of worry experienced by people with a diagnosis of GAD. One potential limitation of these findings relates to a discrepancy in the literature regarding the appropriate cut-off score to define clinically significant worry. The cut-off score of 44 is contested by Startup & Erickson (2005) who propose a cut-off of 67. Nevertheless, Behar and colleagues (2003) found the cut-
of 44 to be both highly sensitive (.99) and specific (.98) suggesting it is sufficiently reliable for this purpose.

**Rumination.** As can be seen in Table 4, seven studies administered a rumination measure to a psychosis sample that had not been screened for level of worry. Five different measures of rumination were employed making comparison of severity levels between samples difficult. Additionally, few studies reported information regarding cut-off scores for clinical significance.

**Table 4: Mean rumination scores in studies with no screening for level of worry.**

| Study                        | Measure | Mean score | | | | Significant difference between psychosis and NC |
|------------------------------|---------|------------|---|---|---|
| Halari et al. (2009)         | RSQ     | 26         | - | - | - |
| Hepworth et al. (2011)       | RSQ     | 58.58      | - | - | - |
| Vorontsova et al. (2013)     | RSQ     | 46.97      | 37.10 | p<.01 |
| Ricarte et al. (2014)        | RRS     | 20.55      | 15.90 | p<.001 |
| Badcock et al. (2011)        | RRS     | 22.64      | 18.79 | p<.001 |
| Thomas et al. (2014)         | RRQ     | 42.7       | - | - | - |
| Rowland, Hamilton, Lino et al. (2013) | CERQ | 12.55      | 10.64 | p<.01 |
| Rowland, Hamilton, Vella et al. (2013) | CERQ | 14.56      | 11.69 | p<.01 |

Five studies compared the level of rumination in a sample of people with psychosis to a non-clinical sample and all found significantly higher levels of rumination in those with psychosis (Badcock et al., 2011; Ricarte et al., 2014; Rowland, Hamilton, Lino et al., 2013; Rowland, Hamilton, Vella et al., 2013; Vorontsova et al., 2013).
Hepworth and colleagues (2011) did not include a non-clinical comparison group, however, they reported that scores above 35 on the RSQ indicated clinical levels of rumination and that the mean level in depressed patients is 46; thus demonstrating that their psychosis sample had a mean level of rumination higher than in people with depression (58.58). Furthermore, they specifically noted that 75% of participants reported rumination levels above the mean for depressed individuals, providing an estimate of prevalence. According to the cut-offs provided by Hepworth and colleagues (2011), the mean level of rumination in the psychosis sample used by Vorontsova and colleagues (2013) indicates a level on a par with people with depression. However, Vorontsova and colleagues (2013) directly compared the level of rumination in a group of people with psychosis against a group with depression and found those with depression to have higher levels (60.47). Nevertheless, a group of people with both psychosis and depression had higher levels of rumination (61.53) than those with psychosis only. Perhaps suggesting that a key factor in the level of rumination in people with psychosis is the presence or severity of depression.

In contrast to Hepworth and colleagues (2011) findings, two non-controlled studies of individuals with schizophrenia found rumination levels similar to those previously observed in the general population (Halari et al., 2009; Thomas et al., 2014). Halari and colleagues (2009) reported a mean level of rumination of 26 indicating rumination levels were not of clinical significance in their psychosis sample. Thomas and colleagues (2014) was the only study to use the RRQ and so the findings cannot be directly compared to the other studies. Despite concluding that rumination levels in their sample were similar to those in the general population, Thomas and colleagues did not report any clinical
significance cut-off scores or mean scores found in the general population, making it difficult for the reader to verify their claim.

Two studies compared the level of rumination in people with psychosis against those with a diagnosis of bipolar disorder (Rowland, Hamilton, Lino et al., 2013; Rowland, Hamilton, Vella et al., 2013). Both studies found no significant difference between the two groups.

Overall it appears that rumination is a highly prevalent psychological process in people experiencing psychosis; it is frequently severe enough to be clinically significant and potentially comparable to the severity of rumination in people with depression, although this may well be due to high levels of depression in the psychosis population. Future research in this area should aim to clarify this.

How are worry and rumination associated with symptoms of psychosis?

Studies measuring worry primarily reported the association with auditory hallucinations and persecutory delusions. Studies measuring rumination reported the association with auditory hallucinations, persecutory delusions and overall severity of psychotic symptoms.

Worry and auditory hallucinations. Five studies explored the relationship between worry and auditory hallucinations. Two cross-sectional survey studies found worry did not significantly correlate with auditory
hallucination severity or distress as measured by the PSYRATS (Badcock et al., 2011; Morrison & Wells, 2007).

Comprehensively, another cross-sectional survey found worry to be significantly moderately correlated with anomalous perception frequency, intensity and distress as measured by the CAPS (Bell et al., 2011). However, given that the CAPS measures perceptual anomalies from several different sensory modalities with no breakdown of the relationships between individual senses, it cannot be confirmed whether the correlation found would apply to auditory hallucinations in isolation.

A cross-sectional experimental study using the CAPS to measure change in anomalous experiences following worry induction gives greater clarity on the types of anomalous experiences affected (Freeman et al., 2013). An increase in worry precipitated an increase in sensations of unreality of self and surroundings (e.g. feeling like a detached observer), perceptual alterations (e.g. body feeling like its floating) and temporal disintegration (e.g. recent events feeling like they occurred a long time ago). A reduction in worry precipitated a reduction in anomalies of sensory intensity (e.g. colours seeming brighter) and sensory flooding (e.g. difficulty distinguishing one sensation from another). Importantly, although a variety of anomalous experiences were affected, presence of hallucinations was unaffected by manipulation of worry, suggesting no relationship exists between the two.

A longitudinal ESM study using a momentary assessment method with high ecological validity and minimal retrospective bias found antecedent worry to predict severity and distress of auditory hallucinations (Hartley et al., 2013).
However, once metacognitive beliefs about worry were accounted for as a moderator, the predictive effect of worry on auditory hallucination severity and distress was significantly reduced.

Despite the small number of studies that have investigated the relationship between worry and auditory hallucinations, there is relative consistency in the finding that worry is not independently significantly associated with auditory hallucinations. Worry may be related to auditory hallucinations but this is likely to be due to a common variable such as metacognitive beliefs.

**Worry and persecutory delusions.** Twelve studies looked at the relationship between worry and persecutory delusions. Six were cross-sectional surveys (Cernis et al., 2014; Freeman & Garety, 1999; Freeman et al., 2010; Morrison & Wells, 2007; Startup et al., 2007; Startup et al., 2016), one was a cross-sectional survey with a two-month follow-up (Vorontsova et al., 2013), four were CBT-based worry interventions (Foster et al., 2010; Freeman et al., 2015; Freeman et al., 2016; Hepworth et al., 2011) and one was a longitudinal ESM study (Hartley et al., 2013).

All the cross-sectional surveys found significant positive correlations between worry and severity of persecutory delusions. The follow-up study found worry predicted persistence of persecutory delusions two months later (Vorontsova et al., 2013). Quality of the studies was weak to moderate.

All the CBT-based worry interventions found significant reductions in worry and persecutory delusion severity and distress (Foster et al., 2010; Freeman
et al., 2015; Freeman et al., 2016; Hepworth et al., 2011). Quality of the studies was moderate to strong.

Overall these studies suggest there is an important relationship between worry and persecutory delusions and, interventions targeting worry, are of clinical value in also reducing persecutory delusions. Nevertheless, more detailed inspection of these studies’ findings highlights some discrepancies. Although worry was shown to be correlated with severity of persecutory delusions in several studies, it was not found to be a significant predictor (Freeman et al., 2010). Interestingly, this study only employed a participant-rated measure of persecutory delusions and not a researcher-rated measure, which is a potential reason why no predictive relationship was found. Another study using both participant-rated and researcher-rated measures of persecutory delusions found further discrepancies. Freeman and colleagues (2016) worry intervention study found greater reductions in persecutory delusions on research-rated measures compared to those rated by the participant.

Hartley and colleagues (2013) found a similar relationship between worry and persecutory delusions as between worry and auditory hallucinations. Antecedent worry predicted severity and distress of persecutory delusions with a moderating effect of negative beliefs about worry. Similarly, Cernis and colleagues (2014) found that a significant positive correlation between worry and persecutory delusions became non-significant once depersonalisation was controlled for. Depression may also play a role in exacerbating worry in individuals with psychosis as those with an additional diagnosis of depression have higher levels of worry than those without such a diagnosis (Vorontsova et
However, no moderation analysis was performed in this study to explore the relationship.

In conclusion, all studies that have investigated the relationship between worry and persecutory delusions have found a significant association between the two. The studies have used varied methodology making the reliability of this relationship more robust. However, the validity of the measurement of persecutory delusions is less certain due to discrepancies between findings based on researcher-rated and participant-rated measures.

**Rumination and auditory hallucinations.** Only two studies investigated the relationship between rumination and auditory hallucinations (Badcock et al., 2011; Hartley et al., 2013). Quality of the studies was rated as moderate and strong respectively. In a cross-sectional survey, rumination was found to have a significant weak correlation with auditory hallucination distress but not severity (Badcock et al., 2011). However, controlling for depression rendered the correlation between rumination and auditory hallucination distress non-significant.

In a six-day, longitudinal ESM study, antecedent rumination predicted severity and distress of subsequent auditory hallucinations (Hartley et al., 2013). However, metacognitive beliefs about rumination had a moderating effect on the relationship between rumination and persecutory delusions such that holding negative beliefs about rumination reduced its predictive effect.

Akin to the conclusions regarding the relationship between worry and auditory hallucinations, the existing evidence does not suggest a strong
relationship between rumination and auditory hallucinations either. Other variables such as depression and metacognitive beliefs appear to play a more important role in maintaining this symptom of psychosis. However, given that only two studies exist of this nature, firm conclusions cannot be drawn and studies involving manipulation of the level of rumination to observe its impact on auditory hallucinations are warranted.

**Rumination and persecutory delusions.** Only two studies explored the relationship between rumination and persecutory delusions (Vorontsova et al., 2013; Hartley et al., 2013). Quality ratings were moderate and strong respectively. Both studies employed elements of a longitudinal design but employed different methodologies, were carried out over different time periods and obtained contrasting results. The follow-up survey conducted by Vorontsova and colleagues (2013) found that rumination did not predict persistence of persecutory delusions over a two-month period. Whereas the six-day ESM study conducted by Hartley and colleagues (2013) found antecedent rumination predicted severity of persecutory delusions and distress a few hours later.

Both studies found additional variables played a role in the impact of rumination on persecutory delusions. Hartley and colleagues (2013) found the predictive effect of rumination was attenuated by the moderating impact of negative metacognitive beliefs about rumination. Vorontsova and colleagues (2013) explored the potential role of depression. They found that individuals experiencing persecutory delusions and depression ruminated more and experienced greater severity of persecutory delusions and associated distress than
those without depression. This suggests that depression is associated with rumination and increased severity of persecutory delusions but as the study did not explore these relationships more thoroughly through a method such as moderation analysis, no conclusions about the nature of the relationship can be drawn.

As with rumination and auditory hallucinations, the relationship between rumination and persecutory delusions has not been adequately investigated. Rumination does not appear to be as important a factor as depression and metacognitive beliefs with regard to its impact on persecutory delusions, however, only tentative conclusions can be drawn on the basis of the existing evidence.

**Rumination and positive and negative symptoms.** Three cross sectional survey studies investigated the relationship between rumination and positive and negative symptoms, as measured by the PANSS or DIP, rather than individual psychotic symptoms. In agreement with findings regarding the relationship between rumination, persecutory delusions and auditory hallucinations, Halari and colleagues (2009) found that positive symptoms were not independently related to rumination, only negative symptoms were. Specifically, rumination was positively correlated with the emotional withdrawal and stereotyped thinking items of the negative symptoms scale. These findings are supported by those of Ricarte and colleagues (2014) who found that rumination was negatively correlated with negative symptoms but not positive symptoms. In partial support of these findings, Rowland, Hamilton, Lino and colleagues (2013) found no significant associations between positive symptoms and frequency of use of rumination in
participants with schizophrenia. However, in contrast to the other two studies, they found no significant relationship between negative symptoms and rumination. This discrepancy in findings may be due the use of different measures. Rowland, Hamilton, Lino and colleagues (2013) used the DIP to measure positive and negative symptoms whereas Halari and colleagues (2009) and Ricarte and colleagues (2014) used the PANSS. Rowland, Hamilton, Lino and colleagues (2013) created the positive and negative symptom scores by summing the scores of certain items from the DIP assessed on the basis of the individual’s experiences over the preceding year. Making these ratings incredibly susceptible to recall bias in comparison to the PANSS which rates symptoms for the preceding week. The potential maximum scores on the positive and negative symptom scales created from the DIP were 25 and 6 respectively. The mean scores for the sample were 2.89 and 0.94 respectively, suggesting the sample was experiencing low levels of symptoms which may explain why no significant relationships were found with rumination.

Overall, the lack of significant relationship between rumination and positive symptoms adds weight to the conclusion that rumination is not a significant factor in the occurrence of psychotic symptoms. It may however play a role in the negative symptoms that characterise a diagnosis of schizophrenia. However, once more due to the very small number of studies in this area no firm conclusions can be drawn and more research is required. Preferably using standardised measures of individual psychosis symptoms making comparison with other studies possible.
Discussion

This review aimed to describe current findings on the nature of the relationship between rumination and worry and symptoms of psychosis by examining the prevalence and severity of worry and rumination in the psychosis population as well as how they were related to symptoms of psychosis.

This review has established that worry and rumination are highly prevalent phenomena in people with psychosis, with significantly higher levels than are found in the general population. In addition, this review has identified robust evidence for a positive association between worry and persecutory delusions and sparse but consistent evidence that worry is not independently associated with auditory hallucinations. As for rumination, this review demonstrates a relative dearth of studies in this area although the existing evidence suggests no significant independent association between rumination and persecutory delusions and auditory hallucinations. However, conclusions about the lack of relationships are tentative and require further investigation.

The high prevalence of worry in people with psychosis suggests it may be a worthwhile target for intervention. Indeed, this review has shown preliminary evidence demonstrating that intervention for worry is not only effective in reducing worry but also precipitates a reduction in severity and associated distress of persecutory delusions. However, the reason why reducing worry reduces persecutory delusions is less clear. Studies in this review show that metacognitive beliefs certainly appear to play a role in the relationship between worry and psychosis. Given that a recent meta-analysis has shown positive beliefs about worry to be more prevalent in individuals with psychosis compared to individuals
with emotional disorders and non-clinical controls (Sellers et al., 2017), future research looking at the relationship between worry, metacognitive beliefs about worry and symptoms of psychosis would be of clinical value in determining methods of intervention.

One limitation of the literature is that the majority of studies investigating worry in psychosis have only explored its relationship with persecutory delusions. Preliminary evidence suggests little or no association between worry and auditory hallucinations, and this may be why further investigation of the relationship has not been pursued. However, robust investigation of the relationship between worry and symptoms of psychosis other than persecutory delusions is a worthwhile direction for future research to bring clarity as to whether this is a field worth pursuing.

Despite the high prevalence of rumination in people with psychosis, as yet, no studies have investigated the impact of intervention on rumination and psychosis symptoms. This is certainly a worthwhile area for future research. Perhaps no such studies have been undertaken as more detailed research into the relationship between rumination and individual psychotic symptoms is less well developed than the equivalent for worry. This review showed studies investigating rumination tended to use global measures of psychotic symptoms such as the PANSS and DIP, whereas studies of worry more frequently used measures that separate out individual symptoms (e.g. PSYRATS); meaning that more detailed information about frequency, severity, preoccupation and distress is provided for each symptom. This echoes a conclusion drawn by Sellers and colleagues (2017) and highlights the need to use multidimensional measures of psychosis symptomology in future research investigating the role of rumination.
Nevertheless, the reviewed studies of rumination showed the importance of considering depression when exploring the relationship between rumination and psychosis as depression may be a more important factor in the severity of psychotic symptoms and associated distress than rumination. Furthermore, relationships between rumination and psychotic symptoms may be accounted for by depression.

The heterogeneity of measures employed by studies to quantify rumination in comparison to the relative heterogeneity of measures used for worry is a potential limitation of this review as it is possible that the variation in findings regarding rumination are a result of differences in the measures used. Creation of a consensus measure of rumination would benefit future research in this area.

Additionally, several studies in this review investigating worry were examining its relationship with persecutory delusions in the context of Freeman’s cognitive model of persecutory delusions (2002) and therefore recruited a sample of people experiencing persistent persecutory delusions consistent with criteria stipulated by Freeman and Garety (2000). Findings may therefore not be representative of the full population of people with psychosis given that it is a heterogenous group (Fusar-Poli et al., 2013).

**Conclusion**

There is increasing recognition of the transdiagnostic importance of cognitive emotion regulation strategies and the need to consider them in research, assessment and treatment of psychopathology (Fernandez et al., 2016). Prior to this review, the only systematic review that specifically examined the role of
worry and rumination within psychopathology, excluded studies of people experiencing psychosis (Querstret & Cropley, 2013).

This review has provided support for current models of psychosis which state that worry is an important factor in the development of persecutory delusions, although further research is required to better understand the mechanics of this relationship. Worry does not appear to be as important a factor in the presence of auditory hallucinations and the role of rumination in the presence of psychotic symptoms is also not well supported. However, very few studies have investigated these relationships relative to the number of studies that have examined the relationship between worry and persecutory delusions. Further research is required to enable more robust conclusions to be drawn.
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Paper Two

An Experience Sampling Study of the Relationships between Worry, Rumination, Sleep Disturbance and Psychosis.

Prepared in accordance with submission guidelines for the Journal of Abnormal Psychology®
An Experience Sampling Study of the Relationships between Worry, Rumination, Sleep Disturbance and Psychosis.

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Abstract

Sleep disturbance is common in people experiencing psychosis. Preliminary evidence suggests sleep disturbance increases severity of psychotic symptoms. Little is known about the mechanisms by which this relationship operates. The purpose of this study was to investigate the role of two key transdiagnostic cognitive emotion regulation strategies, worry and rumination, in the relationship between sleep disturbance and psychotic symptoms. Eighteen adults with a diagnosis of a schizophrenia spectrum condition and self-reported difficulties initiating and maintaining sleep took part in a 7-day study employing experience sampling methodology (ESM) in conjunction with actigraphy. Actigraphy provided objective measurement of sleep efficiency, sleep fragmentation and total sleep time. ESM enabled momentary assessment of severity of worry, rumination, persecutory delusions, auditory hallucinations and distress resulting from each of the two psychotic symptoms. Multi-level modelling revealed that sleep disturbance did not predict severity of next-day worry, rumination, or psychotic symptoms and that worry and rumination did not moderate the magnitude of the relationship between sleep disturbance and psychotic symptoms. Worry and rumination predicted increased severity of concurrent auditory hallucinations but only worry predicted concurrent persecutory delusions. However, effect estimates were small suggesting the proposed relationships must be considered tentative. A role for sleep disturbance in predicting severity of psychotic symptoms is not supported. Evidence for the role of worry and rumination in predicting severity of psychotic symptoms is reported and worry appears to be of greater importance than rumination.

Keywords: worry, rumination, sleep disturbance, psychosis, schizophrenia, delusion, hallucination,
People who experience psychosis often have problems sleeping. This study showed that objective sleep disturbance did not predict next-day worry, rumination, or psychotic symptoms and that worry and rumination did not moderate the magnitude of the relationship between sleep disturbance and psychotic symptoms. This study showed that worry and rumination did predict concurrent psychotic symptoms and distress.
Introduction

The presence of sleep disturbance in people who experience psychosis has been well established. Meta-analyses have shown that people with a diagnosis of schizophrenia have increased sleep onset latency, decreased total sleep time and decreased sleep efficiency in comparison to healthy controls (Chan, Chung, Yung & Yeung, 2017; Chouinard, Poulin, Stip & Godbout, 2004). The negative impact of such sleep disturbance is becoming increasingly apparent as links have been identified between sleep disturbance and poorer functioning (Mulligan, Haddock, Emsley, Neil & Kyle, 2016), decreased quality of life (Ritsner, Kurs, Ponizovsky & Hadjez, 2004) increased suicidal ideation (Andriopoulos, Ellul, Skokou & Beratis, 2011) and impaired cognitive performance (Bromundt et al., 2011).

However, the nature of the relationship between sleep disturbance and psychosis symptomology remains poorly understood (Wulff, Gatti, Wettstein & Foster, 2010). Studies of the general population have found sleep deprivation induces psychosis-like symptoms (Petrovsky et al., 2014) and insomnia symptoms are associated with higher levels of persecutory ideation (Freeman, Pugh, Vorontsova & Southgate, 2009). Studies of the psychosis population have found preliminary evidence suggesting changes in sleep-wake patterns are associated with changes in severity of psychotic symptoms and that negative affect mediates the relationship between sleep efficiency and psychosis severity (Mulligan et al., 2016; Waters et al., 2011). Negative affect is an important predictor of psychotic symptoms and associated distress (Smith et. al. 2006) and a vicious cycle is thought to exist between negative affect and psychotic symptoms resulting in the maintenance of both experiences (Krabbendam et. al., 2005).
Transdiagnostic approaches to psychopathology highlight the importance of cognitive emotion regulation strategies in managing negative affect (Aldao, 2012). These strategies are defined as “cognitive responses to emotion-eliciting events that consciously or unconsciously attempt to modify the magnitude and/or type of individuals’ emotional experience or the event itself” (Aldao & Nolen-Hoeksema, 2010). Worry and rumination are two such emotion regulation strategies. Worry and rumination are associated with many different psychological difficulties including anxiety, depression, insomnia, substance misuse and eating disorders. (Aldao, Nolen-Hoeksema & Schweizer, 2010; Harvey, Watkins, Mansell & Shafran, 2004; Watkins, 2008). They have been shown to be distinct phenomena within both insomnia (Carney, Harris, Moss & Edinger, 2010) and psychosis (Hartley, Haddock, Vasconcellos e Sa, Emsley and Barrowclough, 2014).

In relation to sleep disturbance, increased rumination is associated with more negative prospective appraisals of sleep quality as well as poorer sleep efficiency and longer duration of night waking in people with insomnia (Carney et. al., 2010). Furthermore, longitudinal assessment of rumination and sleep disturbance in students with depression found increased pre-sleep rumination predicts longer sleep onset latency; such that a one standard deviation increase in rumination was associated with a seven-minute increase in actigraphy measured sleep onset latency (Pillai et al., 2014). People with insomnia experience large amounts of uncontrollable worry during the pre-sleep period and are more prone to worry during the day (Harvey, 2002). Experimental manipulation of worry has shown its negative impact on subjective sleep quality, sleep onset latency and total sleep time (Tang & Harvey, 2004a; 2004b). Worry and rumination about sleep disturbance itself also leads to
further sleep disturbance, suggesting the presence of another vicious cycle (Carney, Edinger, Meyer, Lindman & Istre 2006; Harvey, 2002).

Evidence is growing to suggest worry and rumination also play a role in psychosis. Dimensions of worry are associated with dimensions of delusional ideation and psychotic experiences (Morrison & Wells, 2007). Worry is associated with high levels of persecutory delusion distress and persistence of delusions over time (Startup, Freeman & Garety, 2007). Rumination is positively correlated with auditory hallucination distress (Badcock, Paulik & Maybery, 2011) and is related to hallucination-proneness through the mediating variable of intrusive thoughts (Jones & Fernyhough, 2009). However, few studies have explored the temporal nature of the relationship between worry and rumination and psychosis. A study by Hartley and colleagues (2014) used Experience Sampling Methodology (ESM) to explore how worry and rumination interact with persecutory delusions and auditory hallucinations on a momentary basis, finding that antecedent worry and rumination predicted the severity of delusional and hallucinatory experience and associated distress.

Taken together, these findings suggest that worry and rumination appear to play a role in both sleep disturbance and psychosis. These relationships seemingly involve complex interactions and directionalsities between variables. ESM is a potentially effective method of exploring dynamic relationships as it enables investigation of interactions between variables on a day-to-day basis within a rich, ecologically valid dataset (Kimhy et al., 2012). Several studies have used ESM with samples of people experiencing psychosis and it has been shown to be an acceptable and feasible method within this population (Myin-Germeys et al., 2003). However, only one study to date has used ESM to explore the impact of sleep disturbance in
people with psychosis (Mulligan et. al., 2016); finding that objective and subjective measures of sleep quality predicted subsequent functioning and severity of psychotic symptoms, and that these relationships were partly mediated by negative affect on wakening.

The current research aimed to further the progress made by Mulligan et al. (2016) in expanding knowledge of the relationship between sleep disturbance and symptoms of psychosis by using experience sampling methodology to examine the potential moderating effect of two key transdiagnostic cognitive emotion regulation strategies, worry and rumination.
Aim and Hypotheses

The principal aim was to investigate the relationship between worry and rumination, sleep disturbance and psychotic symptoms in people experiencing psychosis.

It was hypothesised that:

1. Greater sleep disturbance would predict greater severity of next day worry and rumination.

2. Greater severity of worry and rumination would predict greater severity of concurrent psychotic symptoms and resultant distress.

3. Worry and rumination would moderate the relationship between sleep disturbance and next-day severity of psychotic symptoms.
Method

Participants

Ethical approval for this study was given by North West Haydock NHS Research Ethics Committee (ref: 16/NW/0172). Permission was granted by research and development offices of five NHS Trusts in the North West of England to recruit participants from their Community Mental Health and Early Intervention for Psychosis services.

Participants were aged 18 or over and were experiencing symptoms consistent with a diagnosis of schizophrenia, schizophreniform disorder, schizoaffective disorder, delusional disorder, psychotic disorder not otherwise specified, or non-affective psychosis, in accordance with the Diagnostic and Statistical Manual for Mental Disorders (DSM-V; American Psychiatric Association, 2013), as confirmed by the clinician in charge of co-ordinating their mental health care. Additionally, participants were experiencing significant sleep disturbance characterised by difficulty initiating or maintaining sleep, as determined by a score above ten on the Insomnia Severity Index (ISI; Bastien, 2000).

Participants were excluded if they (i) were an inpatient, (ii) had a known organic condition or learning disability, (iii) were unable to understand and speak English to a level sufficient to give consent and complete the study, (iv) were engaging in problematic alcohol or substance use as determined by a score above ten on the Alcohol Use Disorders Identification Test (AUDIT; Saunders, Aasland, Babor, De la Fuente, & Grant, 1993) and above eleven on the Drug Abuse Screening Tool (DAST; Skinner, 1982), and (v) had a sleep disorder identified by the Brief Screen for Sleep Disorders (Wilson et al., 2010). Sleep disorders included
narcolepsy, restless leg syndrome, sleep apnoea, circadian rhythm phase delay and parasomnia.

**Screening measures.** The following measures were used to determine participant suitability for the study according to the inclusion and exclusion criteria.

*Drug Abuse Screening Test (DAST; Skinner, 1982).* The DAST is a 28-item self-report measure designed to quantify severity of substance use. It has good reliability and validity (Yudko, Lozhkina & Fouts, 2007). Scores above 11 indicate problematic substance abuse in a psychiatric population (Staley & El-Guebaly, 1990).

*Alcohol Use Disorders Identification Test (AUDIT; Saunders et al., 1993).* The AUDIT is a 10 item self-report measure designed to quantify alcohol use. It has good reliability and validity and scores above 10 indicate problematic alcohol use in a psychiatric population (de Meneses-Gaya, Zuardi, Loureiro & Crippa, 2009).

*Insomnia Severity Index (ISI; Bastien, 2000).* The ISI is a brief screening measure of insomnia assessing a person’s current perception of symptom severity, distress and daytime impairment. It has excellent internal consistency and adequate discriminatory and convergent validity. A cut-off score of 10 is thought to be optimal for detecting insomnia in a community sample (Morin, Belleville, Bélanger & Ivers, 2011).
Brief Screen for Sleep Disorders (BSSD; Wilson et. al., 2010). The BSSD is a five-item screening tool that was used to screen out individuals with narcolepsy, sleep breathing disorder, periodic limb movement syndrome and restless leg syndrome, circadian rhythm sleep disorder, and parasomnia.

**Baseline measures.** The following measures were used for baseline assessment of overall psychopathology, psychosis and depression. This information was required to characterise the sample and control for confounders in the analysis.

**Positive and Negative Syndrome Scale (PANSS; Kay, Fiszbein & Opler, 1987).** The PANSS is a 30 item semi-structured interview measure assessing overall psychopathology. Items are rated by the interviewer on a scale of 1 (absent) to 7 (extreme) creating a total score range of 30 to 210 with high reliability and validity (Kay, Opler & Lindenmayer, 1988). PANSS scores were used to characterise the sample and control for overall psychopathology in the analyses. Inter-rater reliability of the researchers was verified against a gold standard (intra class correlation coefficient (ICC; .77-.91) and between researchers (ICC .82-.99).

**Psychotic Symptom Rating Scale (PSYRATS; Haddock, McCarron, Tarrier, & Faragher, 1999).** The PSYRATS is a semi-structured interview measure consisting of 11 items assessing dimensions of auditory hallucinations and six items assessing dimensions of delusional beliefs. Items are scored 0–4 with higher scores indicating greater severity. The PSYRATS has high validity and reliability (Haddock et al., 1999) within psychosis samples.
Calgary Depression Scale for Schizophrenia (CDS; Addington, Addington, & Maticka-Tyndale, 1993). The CDS is a nine item semi-structured interview measure of depression severity for use with people with a diagnosis of schizophrenia. Items are scored 0-3 with higher scores indicating greater severity. The CDS has proven reliability and validity for use with individuals with a diagnosis of schizophrenia (Addington et al., 1993).

Daily Sleep Measures

Actigraphy. Patient Recorded Outcome Diaries (PRO-Diary; CamNtech Ltd, Cambridge) set-up using PRO-Diary software version 1.2.3 were used for wrist actigraphy measurement of sleep-wake patterns with an epoch of thirty seconds. The PRO-Diary was chosen for actigraphy measurement due to its additional questionnaire function enabling presentation of the ESM items detailed below. Actigraphy provides objective information on sleep habits in a person’s natural sleep environment and has been well validated for the estimation of night-time sleep variables in several different populations (Martin & Hakim, 2011) and in people experiencing symptoms of psychosis (Baandrup & Jennum, 2015). Participants were asked to wear the PRO-diary on their non-dominant wrist continuously for seven days and nights only removing it during water activities (i.e. when showering, washing or swimming). MotionWare software version 1.1.20 was used to extract the following three sleep variables:

- Total Sleep Time (TST): Total time spent in sleep according to the epoch-by-epoch wake/sleep categorisation.
• Sleep Fragmentation (SF): The sum of the mobile time (%) and the immobile bouts <=1 minute (%).

• Sleep Efficiency (SE): Total sleep time expressed as a percentage of time spent in bed.

Consensus Sleep Diary. The Consensus Sleep Diary (Carney et. al., 2012) is a self-report paper diary that was employed to supplement the actigraphy data. Participants used it to record the time they went to bed and got out of bed. This information was necessary for the MotionWare software to calculate sleep variables as it identifies the sleep period to be analysed. Participants were asked to complete the diary within fifteen minutes of their final awakening.

ESM Measures

The following items were presented on the PRO-Diary screen following an alarm at each timepoint as detailed in the ESM phase of the procedure. Items were preceded by the statement “At the moment” to prompt participants to respond according to their current experiences. Items were rated for severity on a scale from 1 (not at all) to 6 (very much).

Worry and rumination. Three items were chosen based on those from a previous ESM study of worry and rumination in psychosis (Hartley et al., 2014). Worry was assessed by the item “I am worrying” and rumination by a combination of two items “I am dwelling on things” and “I am going over my problems in my mind”. A mean rumination score was calculated from the two rumination items.
**Psychotic symptoms and associated distress.** Two items were used from a previous ESM study of psychosis (Mulligan et al., 2016). Auditory hallucinations were measured by the item “I am hearing voices that other people cannot hear” and persecutory delusions by the item “I am feeling that someone/something may try to cause me harm”. Each psychotic symptom item was succeeded by the item “This is distressing” to measure the distress felt as a result of the symptom.

**Positive and negative affect.** These items were administered for the purpose of another study led by author HL and the scores are therefore not reported here. They also served as a validity check for participant responses as observations consistently answered with a score of 4 (the default cursor starting point for the 1-6 Likert scales on the PRO-Diary) were unlikely to have been a true reflection of the participant’s experiences given that it was highly unlikely a person would score 4 for items measuring positive affect as well as negative affect.

**Procedure**

**Recruitment/screening phase.** All participants were recruited by authors AFH and HL for whom the study constituted part fulfilment of doctoral theses. Participants were identified and initially informed about the study by a member of their Community Mental Health or Early Intervention for Psychosis Team. Participants who gave verbal consent to be contacted were telephoned by the researchers to discuss the study in detail and complete screening measures to determine whether the study was suitable for them in accordance with the inclusion and exclusion criteria. Participants for whom the study was not suitable were
debriefed immediately. Eligible participants were asked to provide their usual sleeping hours for use in programming the PRO-Diaries.

**Baseline phase.** All participants were visited in their own homes to provide written consent to participate, to complete baseline measures and to learn how to use the PRO-Diary and complete the sleep diary. Participants had the opportunity to trial answering the ESM items and ask the researchers any questions about the PRO-Diary. The importance of answering the ESM items according to the participant’s experience at the time of answering, rather than how they think or feel generally, was emphasised.

**ESM phase.** Participants wore the PRO-Diary for seven consecutive days. PRO-Diaries were programmed to emit an alarm at five time points spaced at three hour intervals over a twelve-hour period of assumed wakefulness each day. Assumed wakefulness was determined by the normal sleeping hours provided by participants during screening. Following the alarm, participants were invited to answer ESM items presented on the PRO-Diary digital screen. Participants could choose not to answer the items or to delay answering by 20 minutes if the timing was not convenient. Participants were telephoned by the researchers 24 hours after starting and half-way through the week to ensure they were not experiencing any problems completing the PRO-Diary or sleep diary.

**Post ESM phase.** Researchers met participants at the end of the seven days to collect the PRO-Diary and sleep diary, to provide a debrief and to give participants a £15 gift voucher as a token of appreciation for their participation.
Statistical Analysis

Analysis was completed using STATA version 14. Histograms of the predictor variables were inspected and found to be adequately normally distributed.

ESM data has a three-level hierarchical structure with observations set within days set within participants. Observations within days and within participants are therefore more highly correlated with each other than with observations from other days or participants. To account for this, Multi-Level Modelling (MLM) was used. MLM uses maximum likelihood estimation and is thus able to manage missing data within observations without needing to exclude the observation or use imputation, hence maximising usage of the available data.

Multi-level models can accommodate covariates to control for confounding variables. Baseline total PANSS score was included as a covariate in all analyses to control for variation in overall psychopathology as a potential confounder.

As the sleep variables (TST, SE and SF) were day-level variables, models including these variables had to be constructed with only two-levels. Therefore, mean daily scores were calculated for variables at the observation level, (i.e. worry, rumination, auditory hallucinations, auditory hallucinations distress, persecutory delusions and persecutory delusions distress) to convert them to day-level variables.

Hypotheses 1. Two-level random intercept models were constructed to determine the effect of sleep variables on worry and rumination.
**Hypothesis 2.** Three-level random intercept models were constructed to determine the effect of worry and rumination on concurrent psychotic symptoms and resultant distress. To control for potential confounding, models using worry as a predictor included rumination as a covariate, and vice versa.

**Hypothesis 3.** Two-level random intercept models were constructed to investigate the relationships between sleep variables, worry, rumination and psychotic symptoms. In each model the interaction between sleep variables and worry or rumination demonstrated the differing relationship between sleep and psychotic symptoms for varying levels of worry or rumination. The model also tested the relationship between sleep variables and next-day psychotic symptoms by testing the fixed effect of sleep variables on psychotic symptoms.
Results

Sample

Thirty-four people were screened for eligibility, 10 were screened out, see Figure 2 for the reasons for exclusion. Of the 24 people identified as eligible, 22 consented to participate. Three did not complete the study and one dataset was not captured due to technical difficulties with the PRO-Diary. The final sample therefore constituted 18 participants. Table 5 presents a summary of participant demographic and clinical characteristics. All but one participant was taking antipsychotic medication including risperidone, flupentixol, quetiapine, olanzapine and clozapine.

Most participants had a diagnosis of schizophrenia (n = 13), three participants had a diagnosis of schizoaffective disorder and two participants had a diagnosis of psychotic disorder not otherwise specified (NOS). Most participants were male (n = 16). The mean time since diagnosis was 9 years 9 months with a considerable range from 1 to 30 years. Mean baseline PANSS score indicates mild overall psychopathology (Leucht et al., 2005). Drug and alcohol use was expectedly low given the inclusion criteria. Mean ISI score indicated clinical levels of insomnia of moderate severity.
Figure 2: Sample size and reasons for exclusion/drop-out

10 screened out:
- No schizophrenia spectrum disorder: 5
- Sleep disorder other than insomnia: 1
- Insufficient sleep disturbance: 2
- Hazardous substance/alcohol use: 2

2 screened in but declined to participate

3 started study but did not complete:
- Lost PRO-Diary: 2
- Did not wear the PRO-Diary: 1

Completed but data not included in analysis:
- Data not captured due to technical difficulties with PRO-Diary: 1

Data included in analysis: 18

34 people screened
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<td>7.22</td>
<td>1-30</td>
</tr>
<tr>
<td>Screening Measures</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ISI Total</td>
<td>18</td>
<td>19.44</td>
<td>4.53</td>
<td>10-26</td>
</tr>
<tr>
<td>AUDIT Total</td>
<td>18</td>
<td>3.61</td>
<td>3.71</td>
<td>0-10</td>
</tr>
<tr>
<td>DAST Total</td>
<td>18</td>
<td>1.44</td>
<td>2.41</td>
<td>0-6</td>
</tr>
<tr>
<td>Baseline Measures</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PANSS Total</td>
<td>18</td>
<td>60.44</td>
<td>14.28</td>
<td>44-92</td>
</tr>
<tr>
<td>PANSS Positive</td>
<td>18</td>
<td>15.33</td>
<td>3.48</td>
<td>10-23</td>
</tr>
<tr>
<td>PANSS Negative</td>
<td>18</td>
<td>14.28</td>
<td>4.85</td>
<td>9-28</td>
</tr>
<tr>
<td>CDS Total</td>
<td>18</td>
<td>6.94</td>
<td>5.64</td>
<td>0-19</td>
</tr>
<tr>
<td>PSYRATS Delusions</td>
<td>18</td>
<td>12.94</td>
<td>6.36</td>
<td>0-22</td>
</tr>
<tr>
<td>PSYRATS Hallucinations</td>
<td>18</td>
<td>16.67</td>
<td>14.66</td>
<td>0-38</td>
</tr>
<tr>
<td>Sleep measures</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TST (minutes)</td>
<td>495</td>
<td>489.1</td>
<td>153.2</td>
<td>62-839</td>
</tr>
<tr>
<td>SE (%)</td>
<td>495</td>
<td>78.13</td>
<td>14.55</td>
<td>14.8-99.2</td>
</tr>
<tr>
<td>SF (%)</td>
<td>495</td>
<td>38.13</td>
<td>21.13</td>
<td>0.1-89.8</td>
</tr>
<tr>
<td>ESM measures</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Worry</td>
<td>335</td>
<td>3.02</td>
<td>1.50</td>
<td>1-6</td>
</tr>
<tr>
<td>Rumination</td>
<td>338</td>
<td>3.03</td>
<td>1.42</td>
<td>1-6</td>
</tr>
<tr>
<td>AH</td>
<td>333</td>
<td>2.66</td>
<td>1.67</td>
<td>1-6</td>
</tr>
<tr>
<td>AH distress</td>
<td>332</td>
<td>2.67</td>
<td>1.67</td>
<td>1-6</td>
</tr>
<tr>
<td>PD</td>
<td>332</td>
<td>2.52</td>
<td>1.60</td>
<td>1-6</td>
</tr>
<tr>
<td>PD distress</td>
<td>332</td>
<td>2.58</td>
<td>1.67</td>
<td>1-6</td>
</tr>
</tbody>
</table>
Adherence

All 18 participants completed the recommended minimum 30% of ESM observations (Palmier-Claus et al., 2011) therefore all data was maintained for analysis. Analysis looked at the night to day relationship therefore actigraphy data from nights 1-6 and ESM data from days 2-7 was used. Of a possible 108 nights of sleep data, 99 (91.7%) complete nights of actigraphy data were recorded and 78 (72%) complete nights of sleep diary data were recorded (time to bed and time rose from bed). For those nights with missing sleep diary data, time to bed and time rose from bed were estimated using the automated scoring feature of the MotionWare software. Of a possible 540 ESM observations, 332 were completed (61.5%).

Sensitivity Analysis

Inspection of the data highlighted 10 potentially invalid observations characterised by a response of 4 to all ESM items. A sensitivity analysis was completed by removing the potentially invalid observations and re-running the statistical analysis to determine whether there was a significant difference between the two sets of results. No significant difference was found therefore the results presented are from the original analysis with the 10 observations kept in the dataset.

Hypothesis 1: Greater sleep disturbance would predict greater severity of next day worry and rumination.

Table 6 presents the fixed effects of actigraphy defined sleep variables, TST, SE and SF on worry and rumination. No statistically significant relationships were found between any of the sleep variables and next day worry or rumination.
Table 6: Fixed effect of sleep variables on next day worry and rumination, controlling for baseline total PANSS score.

<table>
<thead>
<tr>
<th>Predictor</th>
<th>Outcome</th>
<th>β coefficient</th>
<th>95% confidence interval</th>
<th>p</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>TST</td>
<td>Worry</td>
<td>-.0006</td>
<td>-.0018 – .0005</td>
<td>.270</td>
<td>94</td>
</tr>
<tr>
<td></td>
<td>Rumination</td>
<td>-.0002</td>
<td>-.0011 – .0007</td>
<td>.704</td>
<td>95</td>
</tr>
<tr>
<td>SE</td>
<td>Worry</td>
<td>-.0095</td>
<td>-.0248 – .0059</td>
<td>.227</td>
<td>94</td>
</tr>
<tr>
<td></td>
<td>Rumination</td>
<td>-.0049</td>
<td>-.0174 – .0076</td>
<td>.442</td>
<td>95</td>
</tr>
<tr>
<td>SF</td>
<td>Worry</td>
<td>.0010</td>
<td>-.0065 – .0085</td>
<td>.792</td>
<td>94</td>
</tr>
<tr>
<td></td>
<td>Rumination</td>
<td>.0020</td>
<td>-.0040 – .0079</td>
<td>.518</td>
<td>95</td>
</tr>
</tbody>
</table>

Hypothesis 2: Greater severity of worry and rumination would predict greater severity of concurrent psychotic symptoms and resultant distress

Table 7 presents the fixed effect of worry and rumination on concurrent auditory hallucinations, persecutory delusions and distress resulting with each symptom. Effect estimates are the regression coefficient expressed as a percentage of the 6-point Likert scale used to measure psychotic symptoms and resultant distress.

Table 7: Fixed effect of worry and rumination on concurrent psychotic symptoms and associated distress, controlling for baseline total PANSS score.

<table>
<thead>
<tr>
<th>Predictor</th>
<th>Outcome</th>
<th>β coefficient</th>
<th>95% confidence interval</th>
<th>p</th>
<th>n</th>
<th>% effect estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Worry</td>
<td>AH</td>
<td>.158</td>
<td>.039 – .278</td>
<td>.010*</td>
<td>333</td>
<td>3.16</td>
</tr>
<tr>
<td></td>
<td>AH distress</td>
<td>.223</td>
<td>.069 – .377</td>
<td>.004*</td>
<td>193</td>
<td>4.46</td>
</tr>
<tr>
<td></td>
<td>PD</td>
<td>.311</td>
<td>.185 – .437</td>
<td>&lt;.001*</td>
<td>332</td>
<td>6.22</td>
</tr>
<tr>
<td></td>
<td>PD distress</td>
<td>.326</td>
<td>.181 – .470</td>
<td>&lt;.001*</td>
<td>198</td>
<td>6.52</td>
</tr>
<tr>
<td>Ruminatin</td>
<td>AH</td>
<td>.393</td>
<td>.260 – .526</td>
<td>&lt;.001*</td>
<td>333</td>
<td>7.86</td>
</tr>
<tr>
<td></td>
<td>AH distress</td>
<td>.610</td>
<td>.436 – .785</td>
<td>&lt;.001*</td>
<td>193</td>
<td>12.20</td>
</tr>
<tr>
<td></td>
<td>PD</td>
<td>.130</td>
<td>-.010 – .269</td>
<td>.069</td>
<td>332</td>
<td>n/a</td>
</tr>
<tr>
<td></td>
<td>PD distress</td>
<td>.428</td>
<td>.264 – .591</td>
<td>&lt;.001*</td>
<td>198</td>
<td>8.46</td>
</tr>
</tbody>
</table>

**Worry.** Worry was a statistically significant predictor of concurrent auditory hallucinations (p=.010) and resultant distress (p=.004). Interpretation of the regression coefficients suggests a one unit increase in worry (e.g. a change from 2 to 3 on the 1-6 worry Likert scale) predicted a 3.16% increase in auditory hallucinations.
(β=.158) and a 4.46% increase in resultant distress (β=.223). Worry was a statistically significant predictor of concurrent persecutory delusions (p<.001) and resultant distress (p<.001). Interpretation of the regression coefficients suggests for every one unit increase in worry there was a 6.22% increase in persecutory delusions (β=.311) and a 6.52% increase in resultant distress (β=.326).

**Rumination.** Rumination was a statistically significant predictor of concurrent auditory hallucinations (p<.001) and resultant distress (p<.001). Interpretation of the regression coefficients suggests for every one unit increase in rumination (e.g. a change from 2 to 3 on the 1-6 rumination Likert scale) there was a 7.86% increase in auditory hallucinations (β=.393) and a 12.20% increase in resultant distress (β=.610). Rumination was not found to be a statistically significant predictor of concurrent persecutory delusions but was a statistically significant predictor of concurrent distress resulting from persecutory delusions (p<.001). Interpretation of the regression coefficient suggests for a one unit increase in rumination there was an 8.46% increase in distress resulting from persecutory delusions (β=.428).

**Hypothesis 3: Worry and rumination would moderate the relationship between sleep disturbance and next-day psychotic symptoms**

Table 8 presents the interactions between the fixed effects of worry and rumination and sleep disturbance on psychotic symptoms, as well as the fixed effect of sleep variables on next-day psychotic symptoms. Worry and rumination were not statistically significant moderators of the relationship between actigraphy defined
sleep variables and next day psychotic symptoms. Indeed, there were no significant relationships between sleep variables and next day psychotic symptoms.

Table 8: Fixed effect of sleep variables on next-day psychotic symptoms, controlling for baseline total PANSS score.

<table>
<thead>
<tr>
<th>Predictor</th>
<th>Outcome</th>
<th>β coefficient</th>
<th>95% CI</th>
<th>p</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>TST</td>
<td>AH</td>
<td>-.0002</td>
<td>-.0010 – .0006</td>
<td>.632</td>
<td>93</td>
</tr>
<tr>
<td>TST</td>
<td>PD</td>
<td>-.0003</td>
<td>-.0007 – .0007</td>
<td>.930</td>
<td>93</td>
</tr>
<tr>
<td>SE</td>
<td>AH</td>
<td>-.0019</td>
<td>-.0087 – .0124</td>
<td>.726</td>
<td>93</td>
</tr>
<tr>
<td>SE</td>
<td>PD</td>
<td>.0031</td>
<td>-.0065 – .0127</td>
<td>.527</td>
<td>93</td>
</tr>
<tr>
<td>SF</td>
<td>AH</td>
<td>.0009</td>
<td>-.0042 – .0059</td>
<td>.735</td>
<td>93</td>
</tr>
<tr>
<td>SF</td>
<td>PD</td>
<td>.0024</td>
<td>-.0021 – .0070</td>
<td>.297</td>
<td>93</td>
</tr>
<tr>
<td>TST</td>
<td>AH</td>
<td>-.0003</td>
<td>-.0011 – .0005</td>
<td>.517</td>
<td>93</td>
</tr>
<tr>
<td>TST</td>
<td>PD</td>
<td>-.0003</td>
<td>-.0011 – .0005</td>
<td>.496</td>
<td>93</td>
</tr>
<tr>
<td>SE</td>
<td>AH</td>
<td>.0020</td>
<td>-.0084 – .0124</td>
<td>.708</td>
<td>93</td>
</tr>
<tr>
<td>SE</td>
<td>PD</td>
<td>.0014</td>
<td>-.0090 – .0118</td>
<td>.791</td>
<td>93</td>
</tr>
<tr>
<td>SF</td>
<td>AH</td>
<td>.0009</td>
<td>-.0041 – .0059</td>
<td>.719</td>
<td>93</td>
</tr>
<tr>
<td>SF</td>
<td>PD</td>
<td>.0026</td>
<td>-.0025 – .0076</td>
<td>.321</td>
<td>93</td>
</tr>
</tbody>
</table>

Table 9: Moderating effect of worry and rumination on the relationship between sleep variables and next-day psychotic symptoms, controlling for baseline total PANSS score.

<table>
<thead>
<tr>
<th>Moderator</th>
<th>Predictor</th>
<th>Outcome</th>
<th>β coefficient</th>
<th>95% CI</th>
<th>p</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Worry</td>
<td>TST</td>
<td>AH</td>
<td>-.0002</td>
<td>-.0008 – .0004</td>
<td>.525</td>
<td>93</td>
</tr>
<tr>
<td></td>
<td>TST</td>
<td>PD</td>
<td>.0003</td>
<td>-.0003 – .0008</td>
<td>.333</td>
<td>93</td>
</tr>
<tr>
<td></td>
<td>SE</td>
<td>AH</td>
<td>-.0056</td>
<td>-.0138 – .0026</td>
<td>.181</td>
<td>93</td>
</tr>
<tr>
<td></td>
<td>SE</td>
<td>PD</td>
<td>-.0020</td>
<td>-.0095 – .0054</td>
<td>.592</td>
<td>93</td>
</tr>
<tr>
<td></td>
<td>SF</td>
<td>AH</td>
<td>.0030</td>
<td>-.0015 – .0075</td>
<td>.191</td>
<td>93</td>
</tr>
<tr>
<td></td>
<td>SF</td>
<td>PD</td>
<td>.0011</td>
<td>-.0030 – .0052</td>
<td>.590</td>
<td>93</td>
</tr>
<tr>
<td>Rumination</td>
<td>TST</td>
<td>AH</td>
<td>.0001</td>
<td>-.0007 – .0006</td>
<td>.878</td>
<td>93</td>
</tr>
<tr>
<td></td>
<td>TST</td>
<td>PD</td>
<td>.0003</td>
<td>-.0004 – .0010</td>
<td>.439</td>
<td>93</td>
</tr>
<tr>
<td></td>
<td>SE</td>
<td>AH</td>
<td>-.0040</td>
<td>-.0122 – .0042</td>
<td>.338</td>
<td>93</td>
</tr>
<tr>
<td></td>
<td>SE</td>
<td>PD</td>
<td>-.0049</td>
<td>-.0132 – .0034</td>
<td>.245</td>
<td>93</td>
</tr>
<tr>
<td></td>
<td>SF</td>
<td>AH</td>
<td>.0020</td>
<td>-.0022 – .0061</td>
<td>.347</td>
<td>93</td>
</tr>
<tr>
<td></td>
<td>SF</td>
<td>PD</td>
<td>.0011</td>
<td>-.0031 – .0053</td>
<td>.600</td>
<td>93</td>
</tr>
</tbody>
</table>
Discussion

There is good evidence to suggest people experiencing psychosis have more disturbed sleep than the non-clinical population, yet research into the cause, impact and treatment is lacking. Two key transdiagnostic processes were investigated in the current study to begin to elucidate the seemingly complex relationships between sleep disturbance, cognitive emotion regulation and symptoms of psychosis.

Worry, rumination, sleep and psychotic symptoms

Our hypotheses regarding the impact of sleep disturbance were not supported as sleep disturbance did not predict increased next day worry or rumination in our sample. Furthermore, worry and rumination did not moderate the relationship between sleep disturbance and severity of psychotic symptoms. Indeed, our findings suggest that sleep disturbance did not predict severity of next day psychotic symptoms, therefore no relationship existed for worry and rumination to moderate. This contradicts the significant relationship between sleep disturbance and next-day psychotic symptoms found by Mulligan and colleagues (2016) despite very similar methodology.

An advantage of ESM is that a large number of observations can be generated from a small sample, enabling greater power. Nevertheless, the larger the sample size the more representative of the population from which it is drawn. Hence, the small size in the present study and that of Mulligan and colleagues (2016) could be the reason for the differing findings. Moreover, the present sample was characterised by lower levels of hallucinations (as indicated by a lower score on the PSYRATS Hallucinations subscale) than Mulligan and colleagues (2016) which may suggest
that the relationship between sleep disturbance and psychotic symptoms is more apparent in individuals experiencing higher frequency or severity of hallucinations.

A recent systematic review has shown that existing evidence linking sleep disturbance to psychotic symptom severity in clinical populations is inconsistent (Reeve, Sheaves & Freeman, 2015). Studies that had examined the association between objectively measured sleep continuity and psychosis severity have obtained differing results with a significant proportion finding no relationship. The majority of studies that found a significant relationship used an inpatient sample, making them potentially unrepresentative of the wider population of individuals who experience psychosis, and certainly different to the entirely community dwelling sample recruited for the current study. Additionally, few studies controlled for confounding psychological factors such as depression or confounding environmental factors such as reduced control over sleep routine when residing on an inpatient ward. Indeed, the current study excluded inpatients on the basis that their sleep data may lack ecological validity, which would negate the purpose of using actigraphy and ESM for its high ecological validity in measuring sleep disturbance and psychotic symptoms.

A further potential distinction between the sample of the current study and many studies in the existing literature is that the current sample was characterised by overall mild levels of psychopathology with an average time since diagnosis of nine years. Given that studies with significant findings have tended to use a sample of inpatients, it is likely that they were more acutely unwell and experiencing higher levels of psychopathology. Clearly, people experiencing psychosis constitute a heterogenous population (Fusar-Poli et al., 2013) and conclusions about the link between sleep disturbance and psychosis severity are limited by the degree of heterogeneity within each study’s sample.
Worry, rumination and psychotic symptoms

Our hypothesis regarding the relationship between worry, rumination and psychotic symptoms was partially supported as both worry and rumination were found to predict increased severity of auditory hallucinations but only worry predicted increased severity of persecutory delusions. Effect estimates were small suggesting the proposed relationships must be considered tentative, nevertheless, it is a strength of this study that effect estimates have been calculated and reported as many studies of this nature do not. The nature of the study design did not allow for causative conclusions to be drawn therefore further research is required to enable firmer inferences to be made.

Arguably, one would expect each variable within this complicated milieu to have a relatively small effect as current models of psychosis suggest that psychotic symptoms result from a combination of variables each making small contributions and interacting with each other to create an overall set of experiences. For example, Freeman’s cognitive model of persecutory delusions (2002) states that people tend to have anomalous internal experiences such as perceptual disturbance at times of significant stress, as well as experiencing anxiety leading to anticipation of danger and interpersonal sensitivity leading to interpretation of threat from others. The cognitive process of worry is an attempt to understand the anomalous experiences and remain alert to potential threat, however it inadvertently maintains and exacerbates negative and implausible ideas leading to the development of persecutory delusions. The model also proposes that sleep disturbance is one cause of anomalous experiences (Freeman and Garety, 2014). Our findings support this model’s proposal that worry contributes to the development of persecutory delusions but not the proposal that sleep also contributes. CBT based worry reduction
interventions are being developed for people with psychosis (e.g. Freeman et al., 2016) with the aim of also reducing severity of psychotic symptoms despite only preliminary evidence regarding the exact nature of the relationship between the two. The current study has been beneficial in furthering current knowledge about the nature of this relationship and supporting argument for the clinical need to consider worry when delivering interventions for psychosis.

With regard to rumination, the findings of the current study suggest it is of less importance than worry in its relationship with psychosis severity. A potential explanation for this may be their difference in orientation in time. Worry is future orientated and focused on anticipation of problems, whereas rumination is past orientated and focused on the meaning of events (Nolen-Hoeksema et al., 2008). Rumination may therefore not predict persecutory delusions as it is not focused on anticipation of future threat. Less theory and research exists into the role of rumination in psychosis compared to worry but rumination has been linked to hallucination-proneness (Jones & Fernyhough, 2009) a finding supported by the current study.

This study has been of value in beginning to clarify a current contradiction in existing findings regarding the relationship between rumination and persecutory delusions. Only two previous studies have investigated the relationship between rumination and persecutory delusions and obtained very different results. Hartley and colleagues (2013) found a significant relationship whereas Vorontsova, Garety and Freeman (2013) did not. A potential explanation of the difference is the different timescales of the predicted relationship and methodologies used to investigate it. Vorontsova and colleagues (2013) used standardised questionnaires to investigate baseline rumination as predictor of severity of persecutory delusions at two month
follow up. Whereas Hartley and colleagues (2013) used ESM to investigate rumination as predictor of severity of persecutory delusions a few hours later. The current study utilised very similar measures and methodology to that employed by Hartley and colleagues (2013) yet did not find the same significant relationship. Two out of the three studies in this area therefore suggest that a significant relationship does not exist between rumination and severity of psychotic symptoms, however, given the very small number of studies further research is necessary for confirmation.

**Conclusions**

This was the first study to examine the potential role of worry and rumination in moderating the previously identified relationship between objective sleep disturbance and severity of psychotic symptoms. Worry and rumination did not moderate the relationship between objective sleep disturbance and psychotic symptoms as the relationship was not found to be significant in this sample. Future research should aim to recruit participants who are more acutely symptomatic or experiencing their first episode of psychosis to address issues of applying findings in this area to a heterogenous population of people with psychosis.

Preliminary evidence for the role of worry and rumination in predicting severity of psychotic symptoms was supported. Worry and rumination were found to predict concurrent severity of auditory hallucinations and worry was found to predict concurrent severity of persecutory delusions. Effect estimates were small and the evidence should therefore continue to be considered preliminary and be investigated further to provide confirmation and explore why these relationships occur.
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hallucinations. *Schizophrenia Research, 86*, 181–188. DOI: 10.1016/j.schres.2006.06.018


Paper Three

Critical Appraisal of the Systematic Review and Empirical Study.

Annabel Fuzellier-Hart
Overall Aim of the Critical Appraisal

The aim of this paper is to provide a critical appraisal of the entire research process including both the literature review and empirical study. The strengths and weaknesses of the review and empirical study are explored as well as the advantages and disadvantages of their respective methodological approaches. Implications for theory and clinical practice are highlighted and suggestions are made for future research. Personal reflections are made about the development and implementation of the research process.
Critical Appraisal of the Literature Review

Aim of the review

The literature review aimed to describe current findings on the nature of the relationship between rumination and worry and symptoms of psychosis. It specifically aimed to determine the prevalence of worry and rumination in the psychosis population and explore how this compared to other clinical and non-clinical populations. It also aimed to explore how worry and rumination are associated with symptoms of psychosis.

Rationale for topic choice

The choice of topic for the systematic review was informed by the topic of the empirical study which investigated the role of worry and rumination in the relationship between sleep disturbance and psychosis. Ideally, the review would have aimed to describe current findings on the nature of the relationship between worry, rumination, sleep and psychotic symptoms. However, preliminary searches of the literature identified that research in this area is virtually non-existent and therefore the scope of the review had to be broadened by removing sleep as a relevant variable. Hence, the review explored worry and rumination only.

Rationale for conducting a systematic review

Preliminary searches of the literature identified the heterogeneity of research in this field. The possibility of conducting a meta-analysis was therefore excluded as
meta-analysis requires the combination of results from similar studies to provide a consistent estimation of the global effect of a procedure on a specified outcome (Delahaye, Landrivon, Ecochard & Colin, 1991). Conducting a systematic review does not necessitate as high a degree of similarity between studies as it aims to answer a specific research question by collating all evidence that fits pre-specified eligibility criteria (Higgins & Green, 2011). A narrative review does not systematically search and include all studies conforming to pre-defined criteria. A systematic review therefore requires considerably more effort than a narrative review but this increased effort is rewarded with substantial advantages. These advantages include minimisation of bias in study inclusion, provision of information about a phenomenon across a wide of settings and empirical methods, use of an explicit, reproducible method, robust conclusions and exploration of inconsistent findings (Higgins & Green, 2011). Given these advantages, a systematic review was chosen as the method to be used to synthesise what appeared to be a relatively disparate field of research.

**Methodological reflections**

Decision making regarding the selection of inclusion and exclusion criteria, search terms and the quality assessment tool are explored here as it was not possible to do so in paper one.

**Inclusion and exclusion criteria.** A scoping exercise was undertaken to determine whether an adequate number of studies had been conducted in the area to make the review worthwhile. The scoping exercise identified a seemingly adequate number of
studies but considerable variety in the research aims of the studies. The inclusion and exclusion criteria were therefore set relatively wide in order to capture the variety of studies in this field.

The scoping exercise was also helpful in identifying that a large number of studies that had investigated worry in people with psychosis, had specifically investigated metacognitive beliefs about worry rather than worry itself. The trainee was aware that a recent meta-analysis had clearly established the propensity for people with psychosis to have positive metacognitive beliefs about worry and therefore deemed no value in replicating this finding. Thus, studies solely investigating worry in psychosis in the context of metacognitive beliefs about worry were excluded.

An additional benefit of the scoping exercise was the opportunity to gain an idea of the number of clinical studies compared to non-clinical studies. There appeared to be a similar number of non-clinical studies as there were clinical studies. It was decided that including the non-clinical studies would render synthesising the findings unmanageable given their heterogeneity and would not add insight into worry and rumination within the psychosis population, as was the review’s aim. Hence, non-clinical studies were excluded.

Studies differed according to whether the relationship between worry/rumination and psychotic symptoms was of primary interest or not. Studies that did not primarily investigate this relationship measured worry and rumination as secondary variables. As such these studies did not provide a substantial amount of relevant information as their research aims were not focused on exploring the relationship between worry/rumination and psychotic symptoms specifically.
Nevertheless, they could not have been excluded as they provided important information about the prevalence of worry and rumination in the psychosis population.

A potential limitation of the review is the use of the inclusion criteria stipulating publication of the study in a peer reviewed journal, which could be criticised for leading to the exclusion of ‘grey’ literature. Grey literature is defined as ‘that which is produced on all levels of government, academia, business and industry in print and electronic formats, but which is not controlled by commercial publishers’ (pg 1; Hopewell, Clarke & Mallet, 2005). Hopewell and colleagues (2005) advocate the inclusion of grey literature in systematic reviews to overcome some of the problems of publication bias. They do however recognise that identifying and including relevant grey literature can be time-consuming and taxing, particularly as assessing methodological quality of such studies can be problematic. It was therefore decided that inclusion of grey literature was beyond the scope if this review.

**Quality assessment.** The use of a quality assessment tool is advised when conducting a systematic literature review to enable appraisal of methodological quality and appropriate analysis of results. Determining the strengths and weaknesses of studies in the review indicates whether biases in the study design or procedure may have unduly influenced the results (Centre for Reviews and Dissemination, 2008).

Choice of quality assessment tool was guided by the literature on quality assessment tools and advice from supervisors. Quality assessment tools designed for appraising clinical trials are well described and evaluated in the literature but less
attention has been placed on evaluating quality assessment tools for epidemiological studies (Sanderson, Tatt & Higgins, 2007). The Newcastle-Ottowa Scale (Wells et al., 2000) is a widely-used quality assessment tool for non-intervention studies that had been adapted previously by trainees looking to assess a similar type of literature. The trainee therefore took a version adapted for a review most similar their own, and further adapted it to ensure the criteria were relevant. Only minor changes were required to the wording of the criteria such as to refer to measures assessing the severity of worry and rumination.

The tool was easy to use and provided a guide to thorough assessment of methodological quality of the studies. A drawback of the tool is that it gives less detailed consideration of the statistical analysis. A potential beneficial addition would be a criterion assessing clarity of statistical reporting to complement the existing criterion assessing appropriateness of the statistical analysis employed. As there were considerable differences between studies in how clearly the analysis was described and the results were presented, making it hard to determine appropriateness of the analysis and accuracy of interpretation of the results.

A potential limitation of the review is that a threshold level of study quality could have been applied as suggested by the Cochrane Consumers and Communication Review Group (Ryan, Prictor & McKenzie, 2013). This would have meant excluding studies if they did not meet a minimum level of quality. This was not done as it was deemed of interest to ascertain as part of the review, exactly how many studies have been conducted in this area. It was also of interest to highlight the quality of the existing studies to advocate for the need of more rigorous research in this area.
Theoretical and clinical implications

It is interesting that several worry intervention studies have been conducted for people with psychosis with the aim of reducing both worry and psychotic symptoms (Foster et al., 2010; Freeman et al., 2015; Freeman et al., 2016; Hepworth et al., 2011), even though prior to this review, no systematic exploration of the literature had been undertaken to confirm the positive relationship between worry and persecutory delusions. Perhaps because the vast majority of studies investigating this relationship have been conducted by the same group of researchers so they are fully aware of the literature in the field. Nevertheless, it is important for the development of theory and clinical practice to review all of the available literature to ensure comprehensive consideration of the evidence for the role of worry and the need for worry intervention. This review provides that evidential mandate for the provision of worry intervention for people experiencing persecutory delusions.

The situation for the role of rumination remains less clear. It appears to be of less importance but has not been as sufficiently explored. An interesting theme within the studies investigating rumination was the role of depression, which was frequently investigated alongside rumination. Rumination and depression are highly correlated (Nolen-Hoeksema, 1991) and some studies controlled for depression whereas others did not, which may explain why they obtained different results regarding the relationship between rumination and psychotic symptoms. Arguably, rumination is a discrete element of depression and therefore controlling for depression may preclude investigation of rumination due to elimination of the variance attributable to it. Aker, Harmer and Landrø (2014) make this argument for a similar situation of investigating emotion regulation in people with depression.
Future studies aiming to clarify the relationship between rumination and psychotic symptoms will need to take this into consideration.

**Personal reflections**

I found a drawback of the research process was the need to design and begin conducting the empirical study before carrying out the literature review. Ideally the literature review would have been conducted first and the findings could have informed the design of the empirical study. Unfortunately, time constraints of the clinical psychology doctorate do not currently allow for this.

In contrast to fellow trainees conducting systematic reviews within research fields with a much more extensive literature base, the number of studies returned by my search terms was relatively low. I was therefore able to conduct screening more rapidly and screen a high proportion of abstracts, theoretically enabling a more thorough screening process. On the other hand, the disparate nature of the studies made synthesising the findings more taxing and impeded the formation of robust conclusions. Despite the arduous nature of some of the elements of carrying out this review, I have learnt invaluable skills in locating and appraising research evidence, an essential skill for clinical psychologists to ensure the use of evidence based practice.
Critical Appraisal of the Empirical Study

Aim of the empirical study

The aim of the study was to investigate the relationship between worry, rumination, sleep disturbance and psychotic symptoms in people experiencing psychosis.

Rationale for topic choice

There is evidence to suggest sleep disturbance (Mulligan, Haddock, Emsley, Neil & Kyle, 2016) and worry and rumination (Hartley, Haddock, Vasconcellos e Sa, Emsley & Barrowclough, 2014) predict severity of psychotic symptoms in people with psychosis. Little evidence exists to explain why these relationships occurs. A vicious cycle may exist in which worry and rumination moderate the relationship between sleep disturbance and next-day psychotic symptoms by magnifying the detrimental impact of sleep disturbance on severity of psychotic symptoms. The empirical study sought to verify this potential moderation and ratify findings of previous studies that sleep disturbance predicts psychosis severity and that worry and rumination predict psychosis severity.

Contribution to the project and recruitment

Difficulties were anticipated in recruiting what was a fairly niche clinical sample of individuals with psychotic symptoms and sleep disturbance equivalent to at least mild insomnia, who were able to participate in a relatively demanding week-
long study. To mitigate this difficulty the decision was made to combine recruitment with another trainee conducting a study in a similar area. This enabled both trainees to recruit more participants to each study and to reduce the burden on both participants and services. Each trainee designed their own study in regular consultation with the other trainee to determine the level of shared methodology between the studies. The studies differed by their measurement of different variables and investigation of different hypothesised relationships. The present study focused on the night to day relationship (i.e. impact of sleep on symptoms) whereas the other study explored the day to night relationship (i.e. impact of symptoms on sleep). Combined they provide a significant addition to this emerging research field.

Both trainees contributed equally to writing the NHS Research Ethics Committee (REC) application, attending mental health team meetings to promote the research, contacting clinicians to identify potential participants, screening potential participants, completing baseline measures and creating the database. Statistical analysis was conducted separately.

The trainee for the current study received advice regarding the statistical analysis from an expert in statistical analysis for ESM studies. ESM data is hierarchical and therefore must be analysed using multi-level modelling to account for correlations in the data. Advice was needed on the construction and interpretation of the multi-level models. This was demonstrated by the statistician and the trainee then analysed and interpreted the results independently.
Rationale for use of ESM

ESM was chosen for the study methodology due to the preponderance of cross-sectional survey studies in this research field and the lack of prospective, longitudinal studies with the ability to more accurately explore the predictive effect of sleep disturbance on worry, rumination and psychotic symptoms. ESM is typically used to explore the relationships between two constructs that vary from moment-to-moment, generating multiple observations for each variable per day and a three-level hierarchical structure to the data. This was the case for the analysis of the relationship between worry and rumination and psychotic symptoms. However, the analysis of the relationship between sleep disturbance and worry/rumination and psychotic symptoms was different as the sleep disturbance variables could only constitute one observation relating to sleep for the whole night. Making the data two-level rather than three-level. The worry/rumination and psychotic symptom data therefore had to be aggregated by creating a mean for each day in order to also make it two-level. Some of the strength of ESM as being sensitive to momentary experiences was therefore lost in the aggregation of the data, however, it remains advantageous in comparison to a single time point administration as the mean for the day remains more representative of the person’s overall experiences that day.

Methodological reflections

Several strengths and limitations of the study were discussed in paper two so will only be summarised here. Rather, limitations and potential improvements of the methodology are expanded upon in greater detail than allowed for in paper two, as well as exploration of issues relating to recruitment.
Chief limitations were the small sample size and chronic, mildly symptomatic nature of the sample which limited generalisability to the greatly heterogenous population of people with psychosis. However, it can be argued that aiming to draw conclusions about the entire psychosis population is a fruitless task due to its heterogeneity and research should instead aim to elucidate relationships between particular transdiagnostic phenomena, as was done by the present study. A key strength was the use of a longitudinal, ecologically valid method allowing predictive relationships to be explored in a field where many studies have used cross-sectional survey methodology.

**Use of the PANSS.** The PANSS is the most widely used measure in the field of psychosis research and is often referred to as the “gold standard” in treatment research due to its sensitivity to change (Waters & Stephane, 2014). However, the PANSS is an extensive assessment requiring a considerable amount of time to complete with the participant as well as requiring an extensive period of training to ensure reliable ratings are made by the administrator. A balance had to be drawn between using a well validated measure that could give an accurate indication of different aspects of symptomology and not fatiguing the participant. In hindsight, using a shortened version of the PANSS such as the 19 item Mini-PANSS (Khan, Lewis & Lindenmayer, 2011) could have been an acceptable alternative, although the trainee was not aware of this measure at the time. However, the Mini-PANSS would still suffer from another criticism of the PANSS in that it is potentially outdated and centred on the medical-model of mental health problems, as is discussed further in the personal reflections section. Another alternative would have been to only use the PSYRATS as a measure of psychotic symptom severity, as has
been done in many other studies of psychosis. In retrospect, the trainee would have opted for this method to reduce participant burden and speed up the recruitment process.

**Piloting.** It is advisable to check the feasibility of a study by conducting a small-scale pilot (Leon, Davis & Kraemer, 2011). The acceptability of the study was checked in consultation with members of the Community Liaison Group at the University of Manchester Clinical Psychology Department. Positive feedback was received regarding the need for research in this area and the acceptability of the study procedure to participants. The ESM phase of the procedure was piloted with two of the trainee’s peers to check acceptability and feasibility of wearing the PRO-diary and answering the ESM items. Of particular interest was whether the watch was comfortable to wear, whether the ESM items were presented at an acceptable frequency throughout the day and whether there were any adverse consequences to participating in the procedure. Positive feedback was received from the pilot participants. They queried the length of some of the ESM items, particularly given the small screen size of the PRO-diary, and these items were subsequently shortened to make them easier to read. Ideally, the study procedure would have been piloted with individuals meeting the eligibility criteria for the study to ensure it was also acceptable to them. However, given the short time span of the project, a decision was made to forgo further piloting and prioritise recruitment of participants to the full study to ensure a sufficient number were recruited. In hindsight, a better approach may have been to conduct further piloting and expand the inclusion criteria to anyone experiencing psychosis in order to facilitate recruitment.
**Screening for delusions and hallucinations.** The type or severity of psychotic symptoms were not an inclusion criterion of the present study. Participants were deemed to have experience of psychotic symptoms on the basis of their diagnosis of a schizophrenia spectrum condition. This is likely to be the reason that the study sample had mild mean levels of psychopathology. It would be of interest in future research of this nature to recruit a sample experiencing more severe levels of psychotic symptoms and possibly to explore group effects by comparing those that experience hallucinations to those that experience delusions. To do this, participants would need to be screened using a measure such as the PSYRATS.

**Recruitment and retention difficulties.** Several difficulties were encountered in the recruitment and retention of participants. Use of the PRO-diaries had significant advantages over the traditional paper diary used in many ESM studies, but also brought some disadvantages. Firstly, the PRO-diaries are expensive so only a limited number were available for this study. This limited the number of people that could be recruited at any one time. The two trainees conducting joint recruitment had the use of six PRO-diaries at the beginning of the study but this reduced to four as two were lost by participants. In addition, not all PRO-diaries could be used at once as it was important to have a PRO-diary spare for demonstration purposes when teaching participants how to use it, as well as to show clinicians at team meetings in order to de-mystify the idea of asking people to wear a ‘sleep watch’. A further technical difficulty with the PRO-diaries was their initial propensity to shed the pins that attached the device to the wrist strap. This resulted in multiple occasions where the researchers had to re-visit the participant during the ESM phase to re-attach a pin.
And may also be why at least one of the watches was lost. Overall these difficulties limited the speed at which participants could be recruited and ultimately the total number of participants recruited within the short time frame available for this research to be conducted.

As mentioned above, another barrier to recruitment was some people’s preconceptions about the experience of wearing a device of the wrist that monitors sleep-wake parameters and asks questions about daily experiences. A potentially valid concern initially highlighted at the NHS REC was that people with psychosis are more likely to become paranoid about electronic monitoring devices and therefore be perturbed by the current study. The researchers argued that individuals with psychosis constitute a heterogenous group with varied beliefs therefore it was unlikely all potential participants would think this way. Moreover, people with these concerns could chose not to participate and a robust risk assessment process was in place to identify and manage this form of risk should it arise once someone began the study.

A final difficulty encountered during the recruitment phase was the demand a week-long study entailed for both the trainee and the participants. Although few participants dropped out of the study once they had started the ESM phase, several participants commented that they had not been able to complete all the questions each day because they were occupied with other things. When participants were contacted during the ESM phase to ensure they were not having problems using the PRO-diary, a few commented that they found the questions slightly annoying at times due to their repetitive nature. Participants were reminded that they were not obliged to answer the questions and could stop at any time. This gives an indication of some of the reasons for missing data. On the other hand, an advantage of the ESM
method is that a large amount of data can still be generated despite participants missing some questions; and multi-level modelling can effectively account for the missing data. It is interesting to consider that paper diary ESM studies often ask participants to answer questions up to ten times a day (e.g. Peters et al., 2012), when five times a day in the present study was too much for some participants. The use of the PRO-diary rather than a paper diary may be the reason for this difference in participant fatigue as a booklet can be more easily set aside than a wrist worn device. This is an important consideration for future research.

Overall, recruitment was complicated and fewer participants were recruited than was planned. The sample was adequate for a study constituting the first of its kind with the intention of determining whether worry and rumination are phenomena worthy of further research in relation to sleep and psychosis. Nevertheless, a larger sample experiencing more acute psychotic symptoms would have been preferable.

**Theoretical implications**

The findings of the empirical study were largely not as expected as sleep disturbance was not found to be a significant predictor of the severity of next-day psychotic symptoms or worry and rumination. Equally, worry and rumination did not moderate the relationship between sleep disturbance and severity of next-day psychotic symptoms as there was no significant relationship to moderate. One hypothesis was supported as worry and rumination were found to predict the severity of concurrent psychotic symptoms.

The discussion of the empirical paper detailed the potential reasons why the hypotheses were not supported and highlighted the disparate nature of the evidence
for the relationship between sleep disturbance and psychotic symptoms. Notably, the large proportion of inpatient studies and relatively sparse inclusion of people living in the community.

The current sample was experiencing less severe levels of psychotic symptoms overall and this implies that theory needs to consider whether the relationship between sleep disturbance and psychosis may only exist in certain subsamples of the psychosis population. For example, people experiencing persecutory delusions rather than auditory hallucinations. Future research could actively recruit such subsamples and make group comparisons to elucidate this area. Certainly, the implication for future theoretical development in this area is that the population to which the theory applies must be clearly described.

Clinical implications

It is important to affirm that the current findings do not negate the clinical importance of good sleep quality and quantity for people with psychosis. It remains an important factor in determining other aspects of clinical relevance such as functioning and quality of life (Mulligan, Haddock, Emsley, Neil & Kyle, 2016; Ritsner, Kurs, Ponizovsky & Hadjez, 2004). Thus, inquiring about sleep quality and quantity and providing intervention for sleep difficulties is still of great importance.

Several participants of the current study fed back during the debrief that they had found it useful to record and reflect on their sleep pattern in more detail. Moreover, they noted feeling more motivated to try to do something to improve their sleep by, for example, finding out about a sleep intervention group offered by their mental health team. Perhaps simply recording one’s sleep pattern can instigate some
change, in the same way as has been found for completion of thought records in instigating belief change in the non-clinical population (McManus, Van Doorn & Yiend, 2012). This could be an interesting avenue for future research and is a useful consideration for clinical practice.

**Personal reflections**

Over the course of the three-year doctoral training programme, I have become increasingly aware of the limitations of diagnostic categorisation and the lack of evidence for the validity of the construct of schizophrenia (Bentall, Jackson & Pilgrim, 1988). My experience conducting this study has demonstrated the reality of this. Every participant I met was an individual with a unique set of experiences inadequately captured by a diagnosis of schizophrenia or schizoaffective disorder. Using this diagnosis as an inclusion criteria has its advantages in categorising the target population for recruitment of the sample and dissemination of the findings in the research literature. However, it may also have limited recruitment as clinicians reported that diagnoses were not always given to service users experiencing psychotic symptoms, particularly those in early intervention services. An alternative would be to screen for current experience of delusions and hallucinations as suggested earlier in this critical appraisal.

Linked to my view of the diagnostic labels of schizophrenia and schizoaffective disorder, I have also become increasingly aware of the outdated nature of some aspects of the PANSS. Primarily, the ‘lack of judgement and insight’ subscale of the PANSS has a medicalised view of psychosis as it asserts that the person must acknowledge that they are ‘ill’ and have a ‘serious mental disorder’ that
requires ‘treatment and hospitalisation’. Arguably this method of assessing insight perpetuates a stigmatising view of the individual’s conceptualisation of their own experiences. This view of psychosis as an illness that must be treated does not allow for alternative perspectives such as the Maastricht Approach (Corstens, Escher & Romme, 2008) which proposes that voice hearing is a reaction to life stresses to which the meaning of the voices may be related. Internalisation of stereotypes, such as that psychosis is a serious mental disorder requiring hospitalisation, is associated with increased low mood and anxiety in people with psychosis (Birchwood, Iqbal & Upthegrove, 2005; Birchwood et al., 2006). Individuals who express a psychological causal explanation of their psychotic experiences have significantly lower levels of stigma (Pyle et al., 2013). Making the way we talk about psychosis of great importance to people’s psychological wellbeing and suggesting that the illness model can be detrimental to wellbeing.

Conducting this study was an invaluable learning experience enabling me to acquire knowledge in the development and implementation of clinical research. I have become very conscious of the need for clinical psychologists to contribute to research, even if all that is possible within the limits of their job role is to promote a positive view of researchers and to support recruitment within their clinical team, this will at least contribute to the feasibility of other people carrying out research.


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Appendix 1: Quality Assessment Tool

Adapted from Mulligan et al. (2016) which was based on the Newcastle-Ottawa Quality Assessment Scale for cohort studies (Wells et al., 2000).

<table>
<thead>
<tr>
<th>Criteria fully met (strong rating)</th>
<th>Criteria partially met (moderate rating)</th>
<th>Criteria not met (weak rating)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Design</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 Aim and hypotheses</td>
<td>The research aim and hypotheses are clearly specified.</td>
<td>Only the research aim OR hypotheses are clearly specified.</td>
</tr>
<tr>
<td>2 Validity of measures</td>
<td>The study uses validated psychosis and worry / rumination measures.</td>
<td>The study uses a combination of validated and non-validated measures.</td>
</tr>
<tr>
<td><strong>Selection</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 Sampling method</td>
<td>The sampling method is described and is adequate for replication.</td>
<td>The sampling method described would require further information to replicate (such as referring to a previously published paper).</td>
</tr>
<tr>
<td>4 Adequacy of screening</td>
<td>The presence of psychotic symptoms was confirmed by administration of a validated measure.</td>
<td>The presence of psychotic symptoms was based on previous diagnoses.</td>
</tr>
<tr>
<td>5 Representativeness of the sample</td>
<td>The sample is generally representative of the average in the target population AND this is clearly demonstrated.</td>
<td>The sample is likely representative of the average in the target population.</td>
</tr>
<tr>
<td>6 Sample size</td>
<td>The study describes an a priori power calculation or other justification.</td>
<td>The study describes a post-hoc justification.</td>
</tr>
<tr>
<td><strong>Procedure</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7 Measurement of variables</td>
<td>The measurement of psychotic symptoms, worry and rumination is described in sufficient detail for replication. Inter-rater reliability is reported for researcher-rated measures.</td>
<td>Measurement is described in enough detail for replication. Inter-rater reliability of research-rated measures is not reported.</td>
</tr>
<tr>
<td>8 Statistical reporting</td>
<td>The statistical test used to analyse the data is clearly described and appropriate, and the measurement of the association is presented, including the probability level.</td>
<td>The statistical test is appropriate. Certain details are missing but there is sufficient information to report.</td>
</tr>
<tr>
<td>9 Confounding variables</td>
<td>The study controls for most confounders.</td>
<td>The study controls for few confounders.</td>
</tr>
</tbody>
</table>