Hallucinations and other psychotic experiences across diagnoses: A comparison of phenomenological features


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ABSTRACT

Although psychotic experiences are prevalent across many psychiatric, neurological, and medical disorders, investigation of these symptoms has largely been restricted to diagnostic categories. This study aims to examine phenomenological similarities and differences across a range of diagnoses.

We assessed frequency, severity and phenomenology of psychotic experiences in 350 outpatients including: participants with schizophrenia spectrum disorders, hearing impairment, Parkinson’s disease, Lewy Body Dementia, Alzheimer’s disease, visual impairment, posttraumatic stress disorder, borderline personality disorder, and participants with recent major surgery. Psychotic phenomena were explored between these groups using the Questionnaire for Psychotic Experiences (QPE).

Participants with major psychiatric disorders reported a combination of several psychotic experiences, and more severe experiences compared to all other disorders. Participants with recent major surgery or visual impairment experienced isolated visual hallucinations. Participants with hearing impairment reported isolated auditory hallucinations, whereas the neurodegenerative disorders reported visual hallucinations, occasionally in combination with hallucinations in another modality or delusions. The phenomenology between neurodegenerative disorders, and within major psychiatric disorders showed many similarities.

Our findings indicate that the phenomenology of psychotic experiences is not diagnosis specific, but may rather point to the existence of various subtypes across diagnoses. These subtypes could have a different underlying etiology requiring specific treatment.

1. Introduction

Psychotic experiences are highly prevalent in patients with many types of psychiatric and neurological disorders and other medical diseases (Sommer et al., 2012). These psychotic experiences are not necessarily a hallmark for psychosis, and reality testing may be intact, especially those with isolated hallucinations in one modality. In combination, hallucinations and delusional ideas can cause severe behavioral disturbances which complicates the care for these patients, especially by non-professional caregivers.

Hallucinations and delusions commonly occur in schizophrenia, with prevalence rates of 59% for hallucinations and 73% of delusions...
visual impairment (Teunisse et al., 1995). Symptoms and severity differ
2015), 16% in hearing impairment (Linszen et al., 2019) and 11% in
(Nagahama et al., 2007), 5–40% in unipolar depression (Toh et al.,
line with RDoC (Teunisse and Rikkert, 2012). Patients with visual impairment can
pairment typically experience auditory hallucinations, including non-
experience.
Auditory hallucinations and delusional perceptions have been ex-
tensively investigated in the context of schizophrenia spectrum dis-
orders, suggesting these experiences to be specifically related to this
disorder. However, recent evidence suggests that these experiences
could be seen as transdiagnostic phenomena (Llorca et al., 2016). For
example, hallucinations in bipolar disorder are known to occur in both
the manic and depressive episodes (Black and Nasrallah, 1989;
Goodwin et al., 2007), and have similar phenomenology as in schizo-
phrenia, such as negative voices, and persecutory delusions (Toh et al.,
2015). Some controversy exists as to whether hallucinations in bor-
derline personality disorder are similar to those in seen psychosis. Traditionally, these hallucinations are deemed pseudo-hallucinations,
because insight into the hallucinations is often intact (Hepworth et al.,
2013). However, more recent studies suggest auditory hallucinations to be
phenomenologically similar in both borderline personality disorder and schizophrenia (Slotema et al., 2012). The same controversy exists
for hallucinations in posttraumatic stress disorder for which phenom-
enological details are still elusive and have yet to be investigated. A
transdiagnostic comparison of hallucinations and delusions in these
disorders could help elucidate this controversy.
Hallucinations and delusions in neurological disorders have mostly
been researched in the context of Parkinson’s disease and dementia with
Lewy bodies, two disorders in which hallucinations and delusions show
many similarities in phenomenology (Aarsland et al., 2001). Psychotic
experiences include visual hallucinations, which are typically animals,
people, or objects (Aarsland et al., 2001; Barnes and David, 2001), and
in later stages of the disease, delusions and hallucinations in other
modalities (Ffytche et al., 2017; McKeith et al., 2004). Delusions of
persecution are among the most prevalent psychotic experiences re-
ported in patients with Alzheimer’s disease (AD) and often occur early
in the disease (Bassiony et al., 2000; Bassiony and Lyketsos, 2003).
These persecutory delusions can relate to theft, infidelity or abandon-
ment (Reeves et al., 2012). Hallucinations in Alzheimer’s disease are
mainly visual or auditory, but hallucinations in other modalities have
also been reported (Bassiony and Lyketsos, 2003).
Hallucinations are not unique to psychiatric or neurodegenerative
disorders, but also occur in patients with sensory impairment. Hallucinations in these patients are often considered transient, without
need for treatment, but could also have a negative outcome with clin-
ical implications (Cox and Ffytche, 2014). Patients with hearing im-
pairment typically experience auditory hallucinations, including non-
verbal sounds, musical hallucinations, but also voices (Linszen et al.,
2019; Teunisse and Rikkert, 2012). Patients with visual impairment can experience hallucinations of patterns, faces, objects, figures and ani-
imals (Jurisić et al., 2018).
As of yet, psychotic experiences are researched within their own
diagnosis; comparisons of phenomenology across the boundaries of
psychiatric and neurological disorders are scant. Changing the per-
spective from a diagnosis-based to a more symptom-based approach, in
line with RDoC (Insel et al., 2010), would facilitate comparison of
psychotic experiences across diagnoses and may point to shared or
different mechanisms underlying these experiences.
Llorca et al. (2016) recently made a first transdiagnostic comparison
of hallucinations between patients with schizophrenia and Parkinson’s
disease. A combination of auditory and visual hallucination was most
common for both groups, whereas hallucinations in schizophrenia were
more severe on any other phenomenological aspect (e.g. frequency,
duration, negative aspects, conviction, etc.).
This study intends to examine the similarities and differences of
psychotic experiences in a wide range of disorders, including clinical
and non-clinical psychotic experiences. The aim is two-fold; first, psy-
chotic experiences in psychiatric and neurological disorders will be
compared across diagnoses within their specialism. We hypothesize
these hallucinations to be highly similar. Second, we will compare
presence and phenomenology of psychotic experiences between the
following five categories; 1) the major psychiatric disorders; 2) neuro-
degenerative disorders; 3) conditions after recent major surgery; 4)
hearing impairment and 5) visual impairment. We hypothesize to find
important differences across these larger groups. Investigating halluci-
inations and delusions regardless of diagnosis can enrich our under-
standing of etiology and treatment needs, and could elucidate possible
subtypes of psychotic experiences across disorders.
2. Methods
2.1. Participants
Participants were recruited from the departments of psychiatry,
audiology, ophthalmology, and intensive care unit (ICU) of the
University Medical Center Utrecht (UMCU), from psychiatry and neu-
rology departments of the VU university medical center in Amsterdam
(VUmc), and from the psychiatric institute PsyQ in The Hague.
Inclusion criteria were; 1) at least ≥18 years of age; and 2) ex-
perienced hallucinations and/or delusions in the past month. All par-
ticipants had to speak or understand the Dutch language and had to be
mentally competent as judged by the treating physician. All participants
provided written informed consent. The study was approved by the
UMCU institutional review board (protocol NL42959.041.13) and was
in accordance with the Declaration of Helsinki.
2.2. Procedures
Participants were selected and approached via their treating phy-
sician and were only included in the current study when they experi-
enced hallucinations or delusions in the last month. Using key questions of
the QPE, the presence of hallucinations and delusions was assessed.
Participants who scored positive on the screening were subsequently
administered the full QPE assessing psychotic experiences in the pre-
ceding week. Participants who did not experience hallucinations or
delusions in the last week, but did experience this in the last month,
were also included in the study. In such cases, the QPE was used to
assess experiences in the last month. Recent major surgery patients
were screened for hallucinations on four consecutive postoperative
days, assessing experiences in the preceding day. Procedures were
identical at all sites. The Mini-Mental State Examination (MMSE;
Folstein et al., 1975) was used to assess the participants’ cognitive state.
Age, gender and education level were also recorded.
2.3. Assessment of psychotic experiences
We assessed psychotic experiences using the QPE. The QPE is a
questionnaire consisting of 50 items that is designed to quantify range
of psychotic experiences, focusing on hallucinations and delusions
(Sommer et al., 2018). In contrast to clinical scales such as the Brief
Psychiatric Rating Scale (BPRS; Overall and Gorham, 1962), the Neu-
ropsychiatric Inventory (NPI; Cummings et al., 1994) and the Positive
and Negative Symptom Scale (PANSS; Kay et al., 1987), this

Lecrubier et al., 2007), often complicated by decreased reality testing. Mild psychotic experiences also occur in 60% of the patients with Parkinson’s disease (Forsaa et al., 2010), 50% of the patients with posttraumatic stress disorder (PTSD) (Anketell et al., 2010) and borderline personality disorder (Kingdon et al., 2010), followed by 43–86% in delirium (Peråli et al., 2010), 11–62% in bipolar disorder (Toh et al., 2015), 25–78% in dementia with Lewy bodies (Nagahama et al., 2007), 5–40% in unipolar depression (Toh et al., 2015), 16% in hearing impairment (Linszen et al., 2019) and 11% in visual impairment (Teunisse et al., 1995). Symptoms and severity differ largely both within and between different diagnostic groups, but similarities are also seen. For example, many patients (with either schizophrenia, borderline personality disorder, Parkinson’s disease or dementia) see scary faces when the sun is setting and respond upset to this experience.
questionnaire not only inquires after problematic and stressful psychotic symptoms, but covers the entire spectrum of psychotic experiences, including misinterpretations, visual illusions, halo seeing/phenomena, incubus and other sleep-related phenomena, sensed presence, passage hallucinations and visions, etc. (Blom, 2010). For this questionnaire hallucination were defined as a perception without a clear source from the environment. There are more complex definitions, for example stating that hallucinations proper should occur with full consciousness, or that hallucinations proper should not have good insight (Waters et al., 2016). These extra definitions were not applied when developing the QPE, making the QPE highly suitable to assess the full spectrum of hallucinations, delusions and psychotic-like experiences of any origin and any duration. The QPE has also proven itself to be a successful tool to investigate the link between psychotic experiences and other disorders such as atopic disorders (Begemann et al., 2019). Likewise, the QPE has been employed in a large-scale study of hallucinations in the general Dutch population during which a relationship between psychotic experiences and processes of auditory language perception (de Boer et al., 2019).

The QPE consists of 50 items categorized into four subscales; Auditory Hallucinations (A); Visual Hallucinations (V); Hallucinations in Other modalities (O); and Delusions (D). The QPE was developed to include the most important psychotic experiences covering all disorders, including auditory, visual, olfactory and tactile hallucinations, sensed presence, illusions, delusional ideation, and delusions. The development and validation of the QPE is further described in Rossell et al. (2019).

2.4. Statistical analysis

A similar approach as in (Llorca et al., 2016) was applied to compare phenomenological features of hallucinations. First, a non-parametric Kruskal-Wallis one-way ANOVA test was used to examine similarities and differences in phenomenology within the categories of major psychiatric and neurodegenerative disorders. Mann-Whitney U tests were used for post-hoc analyses. Secondly, to facilitate comparison of psychotic experiences across diagnoses, all participants were subdivided over five categories; 1) major psychiatric disorders; 2) neurodegenerative disorders; 3) recent major surgery; 4) hearing impairment; 5) visual impairment, as presented in Table 1. A Venn diagram was used to examine differences in symptomatology across these categories. Differences in categorical data were tested with a χ² test or Fisher's exact test. Statistical analyses were conducted in SPSS (version 24.0) and R-software (version 1.0.136) (https://www.r-project.org/). To correct for multiple testing, results are reported with a Bonferroni correction.

3. Results

3.1. Participants

A total of 350 participants were administered a QPE, including patients with a confirmed diagnosis of a) schizophrenia spectrum disorder; b) mood disorder; c) post-traumatic stress disorder; d) borderline personality disorder; e) Parkinson’s disease; f) dementia with Lewy bodies; g) Alzheimer’s disease; h) recent major surgery; i) visual impairment (visual acuity < 0.5 in both eyes); and j) hearing impairment in at least one ear (defined as High Fletcher Index > 25 dB; mean of hearing thresholds at 1000/2000/4000 Hz; as measured by calibrated, pure tone audiometry). Some recent major surgery patients fulfilled criteria for delirium (i.e. had a positive Confusion Assessment Measurement score (CAM-ICU; Ely et al., 2001) or clear indications for delirium present in medical record) 4 days post operation, and others experienced hallucinations in a non-delirious state. See Table 1 for participant characteristics. The average MMSE score in the neurodegenerative group was 24 (range 11–30). The QPE was scored with additional information of an informant in the few participants (n = 3) in the neurodegenerative group with a low MMSE score (<20).

3.2. Phenomenological comparison within the major psychiatric category

Phenomenological aspects of auditory and visual hallucinations were compared between participants with a schizophrenia spectrum, borderline personality disorder, posttraumatic stress disorder and mood disorder. As is presented in the upper row of Fig. 1, most hallucinatory features were highly similar between the groups. Frequency (Kruskal-Wallis H test: H[3] = 11.7; p = .008) and duration (H[3] = 10.5; p = .015) of the auditory hallucinations significantly differed between groups. Post-hoc tests indicated that patients with posttraumatic stress disorder experienced auditory hallucinations less often (p = .040, adjusted for multiple testing), and with a shorter duration than patients with schizophrenia (p = .016, adjusted for multiple testing). The characteristics of visual hallucinations were not significantly different between the four groups (H[3] ≤ 5.28; p ≥ .152 for all).

Table 1
Participant characteristics of the total sample (n = 350).

<table>
<thead>
<tr>
<th>Disorder</th>
<th>n</th>
<th>Age</th>
<th>Education</th>
<th>Gender Females</th>
<th>Total MMSE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Major psychiatric disorders</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Schizophrenia spectrum disorder</td>
<td>127</td>
<td>39.9 (13.9)</td>
<td>4.3 (2.0)</td>
<td>44.9</td>
<td>27.6 (2.0)</td>
</tr>
<tr>
<td>Mood disorder</td>
<td>9</td>
<td>43.7 (17.1)</td>
<td>5.5 (1.8)</td>
<td>55.6</td>
<td>28.5 (1.4)</td>
</tr>
<tr>
<td>Borderline personality disorder</td>
<td>25</td>
<td>42.5 (13.7)</td>
<td>3.3 (0.5)</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>Post-traumatic stress disorder</td>
<td>25</td>
<td>44.7 (9.4)</td>
<td>3.6 (2.1)</td>
<td>84.0</td>
<td>26.3 (4.0)</td>
</tr>
<tr>
<td>Neurodegenerative disorders</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dementia with Lewy bodies</td>
<td>22</td>
<td>69.4 (5.5)</td>
<td>5.1 (2.0)</td>
<td>9.1</td>
<td>23.3 (5.4)</td>
</tr>
<tr>
<td>Parkinson’s disease</td>
<td>19</td>
<td>68.7 (8.2)</td>
<td>5.3 (1.8)</td>
<td>52.6</td>
<td>26.2 (4.8)</td>
</tr>
<tr>
<td>Alzheimer’s disease</td>
<td>6</td>
<td>69.5 (9.6)</td>
<td>5.3 (1.8)</td>
<td>33.3</td>
<td>23.8 (2.4)</td>
</tr>
<tr>
<td>Recent major surgery</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No - delirium</td>
<td>46</td>
<td>68.5 (9.3)</td>
<td>5.4 (2.3)</td>
<td>32.6</td>
<td>28.0 (2.7)</td>
</tr>
<tr>
<td>Delirium</td>
<td>14</td>
<td>71.5 (7.3)</td>
<td>4.9 (2.5)</td>
<td>21.4</td>
<td>27.6 (2.4)</td>
</tr>
<tr>
<td>Hearing impairment</td>
<td>87</td>
<td>56.6 (14.6)</td>
<td>5.5 (1.9)</td>
<td>50.6</td>
<td>28.7 (1.6)</td>
</tr>
<tr>
<td>Visual impairment</td>
<td>19</td>
<td>76.3 (12.5)</td>
<td>4.8 (1.9)</td>
<td>52.6</td>
<td>28.6 (3.6)</td>
</tr>
</tbody>
</table>

Education is assessed by applying Verhage system (7 categories; Verhage, 1964). Abbreviations: M mean; MMSE Mini-Mental State Examination; SD Standard Deviation.
3.3. Phenomenological comparison within the neurodegenerative category

A comparison of auditory and visual hallucinations in patients with Parkinson’s disease, dementia with Lewy bodies and Alzheimer’s disease is displayed in the lower row of Fig. 1. Significant differences were found between emotional valence of the auditory and visual hallucinations between the three groups (auditory $H[2] = 6.6; p = .037$; visual $H[2] = 6.3; p = .042$). Post-hoc tests revealed that the emotional valence was more severe (i.e. content was more often negative) in participants with Alzheimer’s disease versus participants with dementia with Lewy bodies for both auditory and visual hallucinations (auditory $p = .038$ visual $p = .035$; both adjusted for multiple testing).

3.4. Presence of psychotic experiences across all categories

The presence of hallucinations and delusions per category are presented in Table 2. The neurodegenerative (87.2%), recent major surgery (95.0%) and visual impairment (94.7%) categories were predominantly characterized by visual hallucinations. Few of these patients endorsed on other symptoms, although a substantial proportion of the patients with a neurodegenerative disorder also experienced delusions (21.3%; see Table 2). Patients with hearing impairment all experienced auditory hallucinations (100%), as well as patients with a major psychiatric disorder (93.4%). Most of the participants with a major psychiatric disorder typically experienced multiple psychotic experiences, such as auditory hallucinations in combination with visual hallucinations. As presented in the Venn diagram of Fig. 2, isolated auditory hallucinations occurred in 11.7% of the patients with a major psychiatric disorder. Isolated visual, tactile or olfactory hallucinations were far less common in this group, and rather co-occurred with hallucinations in other modalities or delusions. Of all participants with a major psychiatric disorder, a total of 14.6% endorsed on all five symptoms (auditory, visual, tactile, olfactory hallucinations and delusions), which was uncommon in all other diagnostic categories.

For other categories of symptoms presented in Table 2, sensed presence was experienced most often in participants with a major psychiatric disorder (39.3%), followed by patients with visual impairment (21.4%) and a neurodegenerative disorder (19.1%). Visual illusions were most common in the neurodegenerative category (46.8%), followed by visual impairment (31.6%) and patients with a major psychiatric disorder (21.2%). The number of hallucinations that were endorsed by each category significantly differed, as well as the number of delusions (see Table 2). The proportion of participants with a major psychiatric disorder experiencing more than one type of hallucination, or more than one type of delusion, was higher than in the other groups. Delusions were most frequent in the major psychiatry category (51.1%), and least frequent in participants with recent major surgery (5.0%). Paranoid delusions were most often present in patients with a major psychiatric disorder (34.0%), as well as in neurodegenerative disorders (8.5%). A detailed overview of the different delusional themes reported in the various disorders can be found in the Supplementary Table 1.

3.4.1. Comparison of phenomenology of auditory and visual hallucinations across all categories

The phenomenological characteristics of auditory and visual hallucinations were subsequently compared between all five major
Table 2
The presence of psychotic experiences and symptoms profiles per category.

<table>
<thead>
<tr>
<th>Category</th>
<th>Major psychiatric disorders (%)</th>
<th>Neurodegenerative disorders (%)</th>
<th>Recent major surgery (%)</th>
<th>Hearing impairment (%)</th>
<th>Visual impairment (%)</th>
<th>Post-hoc</th>
</tr>
</thead>
<tbody>
<tr>
<td>Auditory hallucinations</td>
<td>93.4</td>
<td>65.1</td>
<td>53.0</td>
<td>53.6</td>
<td>49.0</td>
<td>0.001</td>
</tr>
<tr>
<td>Visual hallucinations</td>
<td>65.1</td>
<td>53.0</td>
<td>49.0</td>
<td>36.1</td>
<td>49.0</td>
<td>0.001</td>
</tr>
<tr>
<td>Objectioal hallucinations</td>
<td>39.3</td>
<td>39.3</td>
<td>39.3</td>
<td>39.3</td>
<td>39.3</td>
<td>0.001</td>
</tr>
<tr>
<td>Sensed presence hallucination</td>
<td>39.3</td>
<td>39.3</td>
<td>39.3</td>
<td>39.3</td>
<td>39.3</td>
<td>0.001</td>
</tr>
<tr>
<td>Visual illusions</td>
<td>39.3</td>
<td>39.3</td>
<td>39.3</td>
<td>39.3</td>
<td>39.3</td>
<td>0.001</td>
</tr>
<tr>
<td>Hallucinations in multiple modalities</td>
<td>26.6</td>
<td>26.6</td>
<td>26.6</td>
<td>26.6</td>
<td>26.6</td>
<td>0.001</td>
</tr>
<tr>
<td>Multiple delusional themes a</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>&lt; 0.001</td>
</tr>
</tbody>
</table>
| Post-hoc analyses compared all phenomenological features between the different diagnostic groups. For auditory hallucinations, the most notable differences were observed between psychiatric disorders versus hearing impairment and neurodegenerative disorders. For hearing impairment, all phenomenological aspects were significantly different, with patients with hearing impairment scoring lower on all items compared to patients with a major psychiatric disorder (p ≤ .001 for all, corrected for multiple testing). The psychiatric and neurodegenerative group did not differ on insight into the auditory hallucinations (p = .673, corrected for multiple testing), but frequency, duration, emotional valence, distress, impact on functioning and interaction were all less severe in neurodegenerative disorders compared to patients with a psychiatric disorder (p ≤ .001 for all, corrected for multiple testing). The phenomenology of auditory hallucinations did not differ between participants with hearing impairment and neurodegenerative disorders (p = 1.00 for all, corrected for multiple testing), except that participants with hearing impairment had more preserved insight in their auditory hallucinations (p = .006, corrected for multiple testing) compared participants with to neurodegenerative disorders.

For visual hallucinations, the most notable finding was that patients with a neurodegenerative disorder and visual impairment did not differ on any of the phenomenological items (p ≥ .946 for all, corrected for multiple testing). Neither did the visual impairment and recent major surgery groups (p ≥ .609 for all, corrected for multiple testing). Participants with a neurodegenerative disorder had less interaction with the visual hallucinations compared to participants with a recent major surgery (p = .002, corrected for multiple testing). Participants with visual impairment and recent major surgery scored significantly lower on emotional valence, distress, impact on functioning, interaction and insight into the hallucinations as compared to participants with a major psychiatric disorder (p ≤ .055 for all, corrected for multiple testing), except that participants with visual impairment did not differ from participants with a psychiatric disorder on insight into reality of the hallucinations (p = .070 corrected for multiple testing). Participants with a neurodegenerative disorder scored significantly lower on emotional valence, distress, impact on functioning and insight (i.e. meaning more insight into their hallucinations) compared to participants with a major psychiatric disorder (p ≤ .016 for all, corrected for multiple testing), but did not differ on interaction with the hallucinations (p = .572, corrected for multiple testing).

4. Discussion

This study provides a phenomenological comparison of psychotic experiences in 350 participants with a wide range of disorders. The Questionnaire for Psychotic Experiences (QPE) was developed to facilitate a transdiagnostic comparison of these psychotic experiences, as it includes symptoms that are usually assessed in a particular disorder only (for example, sensed presence in neurodegenerative disorders). Participants in this sample all endorsed psychotic experiences in the last month, which allowed us to explore differences and similarities in phenomenological features between a variety of diagnostic groups.

A comparison of the phenomenology of psychotic symptoms within the major psychiatric category indicated that auditory and visual hallucinations were largely similar in phenomenology in participants with...
borderline personality disorder, posttraumatic stress disorder, mood disorder, and a schizophrenia spectrum disorder, suggesting that hallucinations in other psychiatric disorders can be just as frequent and distressing as in a primary psychotic disorder. Psychotic experiences within the neurodegenerative disorders were also largely identical. Participants with Parkinson's disease and dementia with Lewy bodies did not differ in phenomenology. Also, exploratory analysis in participants with Alzheimer's disease pointed towards similar psychotic experiences as in the other neurodegenerative disorders.

Whereas large similarities were seen within specific disease domains, differences were observed across domains. Our results suggest that participants with a major psychiatric disorder such as schizophrenia, posttraumatic stress disorder and borderline personality disorder can experience isolated auditory hallucinations, but more often...
experience a diffuse set of hallucinations in different modalities co-occurring with delusions. This contrasts with findings in ICU participants with recent major surgery, and in those with hearing or visual impairment, who merely experienced isolated hallucinations in one modality (e.g., auditory or visual hallucinations) without comorbid hallucinations. The majority of participants with hearing and visual impairment did not endorse delusions, and often had preserved insight in their hallucinations. This could be of additional value in discriminating between hallucinations due to neurodegenerative disorders versus hearing or visual impairment, as a larger proportion of the participants with neurodegenerative diseases did also endorse delusions. Also, it is known from the literature that sensed presence is a common symptom for Parkinson’s disease (Fénelon et al., 2011), but this symptom is rarely assessed in psychiatric disorders. Our results show that sensed presence was mainly experienced by participants with a major psychiatric disorder (39.3%), neurodegenerative disorders (19.1%) and in participants with visual impairment (21.4%). Visual illusions were most frequent in neurodegenerative disorders, but also in participants with visual impairment, which makes it difficult to discriminate between these disorders based on this symptom. In contrast, our results suggest that the co-presence of delusions, especially Cotard's and Capgras' syndrome, are more indicative of a neurodegenerative disorder than of visual impairment. Delusions were most common in schizophrenia spectrum disorders (51%), followed by the neurodegenerative group (21.3%). In both groups, paranoid themed delusions or delusional ideas were endorsed most frequently. Delusions of misidentification (Capgras syndrome) and nihilism (Cotard's syndrome) were endorsed by both schizophrenia and neurodegenerative disorders.

Taken together, this study investigated similarities and differences in psychotic experiences across a wide range of disorders. The results indicate that psychotic experiences are not specific for a particular diagnosis (i.e. schizophrenia) or group of diagnoses (major psychiatric disorders), but should be seen as transdiagnostic experiences. We observed prominent differences in phenomenology across the larger diagnostic categories (psychiatric, neurodegenerative, post-surgery and sensory impairment), such clear differences in phenomenology could suggest a different mechanism underlying the psychotic experiences in these groups. On the other hand, we found striking similarities within these larger categories, suggesting that participants with the same phenomenological subtype of psychotic experiences (for example those with schizophrenia, borderline personality and posttraumatic stress disorder) may have a shared underlying neural mechanism, although this hypothesis is in need of verification.

The need for a transdiagnostic tool was emphasized by the wide variety of psychotic experiences presented per disorder. Use of this general questionnaire provided a more complete overview of psychotic experiences across disorders, facilitating symptom-focused research following RDoC criteria (Insel et al., 2010). A complete overview of psychotic experiences could help establish the presence of possible risk factors for later development of psychosis, leading to the implementation of early prevention strategies. Hallucinations or delusions experienced in isolation could be predictive of psychosis, although the odd's ratio tends to be low (Daalman et al., 2016; Poulton et al., 2000). However, when more psychotic experiences are present (i.e., auditory hallucinations accompanied by reduced reality testing and loss of insight) the risk of full-blown psychosis rises (Askenazy et al., 2007; Daalman et al., 2016, 2011; Kaymaz and van Os, 2016; Krabbendam et al., 2004). As such, our results indicate that the presence of psychotic experiences per se are not indicative of psychosis, but that a multitude of psychotic experiences in combination with lack of insight or decreased reality testing should be at the center of attention.

Our results confirm previous findings that similar phenomena can exist across disorders (Daalman et al., 2011; Larøi et al., 2012; Llorca et al., 2016; McCarthy-Jones et al., 2014; SLOTEMA et al., 2012). In line with the study of Aarsland et al. (2001), our results revealed that psychotic experiences in dementia with Lewy bodies and Parkinson’s disease were highly similar. Paranoid delusion was the most common delusion reported by participants with a neurodegenerative disorder in our study, which is similar to previous studies (Aarsland et al., 2001; Chou et al., 2005; Reeves et al., 2012). Furthermore, Llorca et al. (2016) showed that 46% of the schizophrenia patients also experience sensed presence. In line with their study, sensed presence was also endorsed in major psychiatric disorders (39.3%) and in participants with visual impairment (21.4%), suggesting that this symptom is not as specific for neurodegenerative disorders as was previously thought. The high rate of participants with a major psychiatric disorder who experienced multiple symptoms is consistent with the previous findings of Llorca et al. (2016) comparing psychotic experiences in schizophrenia and Parkinson’s disease.

The findings of this study should be interpreted in light of some limitations. Our participants were all outpatients and differ from unselected community-based patients; generalizability of our findings to more severely affected inpatients should be done with care. For example, the patients with schizophrenia had relatively preserved insight into the unreal character of their hallucinations, which might differ from severely affected inpatients. While this selection might not represent more severe cases, it could be a good reflection of patients’ experiences outside of a clinical setting increasing the external validity of the study. Since only the most severely affected cases require in-patient care this sample portraits more widespread aspects of psychotic experiences. Furthermore, it should be taken into consideration that the
statistical power to detect differences between features of auditory and visual hallucinations within the psychiatric and neurodegenerative categories was limited due to relatively small samples. The groups of participants with Alzheimer's disease and with a mood disorder were particularly small, and should thus be viewed as exploratory findings. Similarities in psychotic symptoms with Alzheimer's disease need to be verified in larger samples, as previous studies indicate that delusions are the most frequently reported psychotic symptoms in Alzheimer's disease (Bassiony et al., 2000), whereas visual hallucinations are most common for Parkinson's disease and dementia with Lewy bodies (Bassiony and David, 2001). Nonetheless, our results were in line with other studies comparing these diagnoses within their specialism, strengthening our finding that the phenomenology between schizophrenia, borderline personality disorder and post-traumatic stress disorder show many similarities (Slotema et al., 2012), as well as in dementia with Lewy bodies and Parkinson's disease (Aarsland et al., 2001).

4.1. Conclusions

The results of this study indicate that for psychiatric disorders, more than one psychotic experience is generally present, and that the phenomenology of psychotic experiences in schizophrenia, posttraumatic stress disorder and borderline personality disorder are largely similar. For neurodegenerative disorders, visual hallucinations are predominant, but hallucinations in other modalities and delusions commonly co-occur. Participants with Parkinson's disease, dementia with Lewy bodies and Alzheimer's disease also had psychotic experiences largely similar in phenomenology. In ICU patients with recent major surgery, as well as in participants with sensory impairment, hallucinations were typically mono-modal and delusions were absent. This suggests the existence of several subtypes of psychotic experiences that occur across diagnostic groups. Investigating hallucinations and delusions regardless of diagnosis can enrich our understanding of etiology and treatment needs, and shed light on possible subtypes of psychotic experiences.

CRediT authorship contribution statement

Maya J.L. Schutte: Investigation, Formal analysis, Writing - original draft. Mascha M.J. Linszen: Methodology, Investigation, Project administration, Formal analysis. Theresa M. Marschall: Writing - review & editing, Visualization. Dominic H. Frytche: Writing - review & editing. Sanne Koops: Investigation, Writing - review & editing. Edwin van Dellen: Writing - review & editing. Sophie M. Herina: Investigation, Project administration, Writing - review & editing. Arjen J.C. Slooter: Conceptualization, Methodology, Investigation, Writing - review & editing. Rob Teunisse: Conceptualization, Writing - review & editing. Odile A van den Heuvel: Conceptualization, Writing - review & editing. Elisabeth M.J. Foncke: Conceptualization, Writing - review & editing. Christina W. Slotema: Investigation, Writing - review & editing. Joop de Jong: Investigation, Writing - review & editing. Susan L. Rossell: Conceptualization, Methodology, Writing - review & editing. Iris E.C. Sommer: Conceptualization, Methodology, Writing - review & editing. Funding acquisition, Supervision.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests personal relationships that could have appeared to influence the work reported in this paper.

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