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Short Communication

When words and pictures come alive: Relating the modality of intrusive thoughts to modalities of hypnagogic/hypnopompic hallucinations

Simon McCarthy-Jones *, Laura J. Barnes, Georgina E. Hill, Lindsey Marwood, Peter Moseley, Charles Fernyhough

Department of Psychology, Durham University, United Kingdom

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ABSTRACT

Hypnagogic and hypnopompic (H&H) hallucinations are those experienced on the borders of sleep and waking. Intrusive thoughts have been proposed to relate to the occurrence of such experiences. In a sample of students ($N = 299$), the present study investigated the relation between auditory and felt-presence H&H experiences, and specific modalities of intrusive thought (auditory and visual) whilst controlling for age, gender, depression, anxiety and thought suppression. The psychometric properties of the Durham Hypnagogic and Hypnopompic Hallucinations Questionnaire (DHQ) were also examined. Exploratory ($N = 299$) and, in a second sample, confirmatory ($N = 502$) factor analyses showed good internal and test–retest reliability for the auditory and felt-presence subscales of the DHQ, but not for the visual subscale. Regression analyses indicated that the sole predictor of auditory H&H hallucinations was intrusive auditory imagery, and the sole predictor of felt-presence H&H experiences was intrusive visual imagery. Explanations for these findings are considered and implications for future research are discussed.

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1. Introduction

Hypnagogic and hypnopompic (H&H) hallucinations are perceptual experiences occurring in the state of drowsiness when going to sleep or waking up, respectively. These experiences can take many forms including hearing one's name being called, seeing faces, animals, or people, as well as experiencing the presence of another person or being. H&H experiences have been found to have a prevalence of 18% in the general population (Ohayon, 2000), and 85% in student populations (Jones, Fernyhough, & Meads, 2009). Understanding the causes of these experiences may help shed light on the cognitive mechanisms underpinning clinically relevant hallucinations.

We recently developed a new tool for assessing the presence of H&H experiences, the Durham Hypnagogic and Hypnopompic Hallucinations Questionnaire (DHQ: Jones et al., 2009). The first aim of the present article (Section 2 below) was to examine the psychometric properties of the DHQ, including an examination of its test–retest reliability and confirmatory factor analysis to test its proposed three-factor structure.

Our second aim (Section 3 below) was to test a model of potential causative variables in the aetiology of H&H hallucinations. It has been proposed (Jones et al., 2009) that thought suppression and intrusive thoughts may play a role in the generation of H&H hallucinations, with suppressed thoughts rebounding intrusively in the period surrounding sleep. Building on findings of relations between intrusive thoughts and H&H hallucinations in both correlational (Jones et al., 2009) and experimental (Schmidt & Gendolla, 2008) studies, the present study aimed to examine whether the modality of intrusive thoughts (auditory/visual) relates to the modality of any H&H hallucinations experienced. We hypothesised that intrusive auditory imagery would correlate with levels of auditory, but not visual or felt-presence H&H hallucinations, and that intrusive visual imagery would correlate with visual, but not auditory or felt-presence H&H hallucinations. Given that both depression and anxiety are positively associated with intrusive thoughts (e.g., Höping & Jong-Meyer, 2003), and that thought suppression has been found to relate to H&H hallucinations, we controlled for these variables.

2. Study 1: Psychometric properties of the DHQ

2.1. Method

2.1.1. Participants

In order to test the factor structure of the DHQ, 299 university students at a UK university (85 female), with a mean age of 20.63 years (SD = 4.9, range = 18–50), who accepted an e-mail invitation to participate, completed the DHQ. A further sample of UK

* Corresponding author. Address: Department of Psychology, University of Durham, South Road, Durham DH1 3LE, United Kingdom. Tel.: +44 1913343240; fax: +44 1913343241.

E-mail address: s.mccarthyjones@gmail.com (S. McCarthy-Jones).

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university students ($N = 502$, 329 female), with a mean age of 19.6 years (SD = 1.5, range = 17–24), completed a revised version of the DHQ (DHQ-R). In this second sample, participants were required to enter an anonymous code allowing a subset of them ($N = 116$, 81 female), with a mean age of 20.1 years (SD = 1.4, range = 18–24), to complete the questionnaires for a second time approximately 3 months later, for the purposes of assessing test–retest reliability. No financial incentive was given for participation. Ethical approval was obtained from the University Departmental Ethics Committee.

2.1.2. Measures and procedure

The Durham Hypnagogic and Hypnopompic Hallucinations Questionnaire (DHQ; Jones et al., 2009) was completed on-line, previously shown to be a reliable way of collecting psychopathology data (Jones, Fernyhough, De-Wit, & Meins, 2008). The DHQ is a 14-item instrument that assesses the presence of auditory, visual and felt-presence H&H hallucinations. Items are scored on a six-point Likert scale ranging with scores calculated for three subscales derived by factor analysis: auditory (DHQ_{aud}), visual (DHQ_{vis}), and felt presence H&H experiences (DHQ_{pres}).

2.2. Results

Using AMOS 7.0, confirmatory factor analysis was performed on the DHQ data ($N = 299$) to test its three-factor structure (Jones et al., 2009). As data for all three DHQ scales was non-normally distributed, fit was adjudged using Bentler and Yuan's (1999) *F* statistic (T_F), a modification of the asymptotically distribution free (ADF) statistic which performs well with non-normal data. A three-factor solution, even after allowing correlated errors (between error terms of items on the same factor, suggested by modification indices), differed significantly from the data, T_F (73, 226) = 1.42, $p < .01$[χ^2_{ADF} (73) = 136.81, $p < .001$, GFI = .91, CFI = .83, RMSEA = .05 (90% CI = .05–.07)].

An exploratory factor analysis using principal components analysis with oblique rotation was then performed to investigate the factor structure of the DHQ in the same sample. Three eigenvalues in excess of one were found (5.06, 2.17 and 1.06), accounting for 59.29% of the variance. Although Kaiser's rule suggested the extraction of three factors, scree plot inspection and parallel analysis using a Monte Carlo analysis with 1000 repetitions suggested that two factors should be extracted. Items were required to load >.5 onto a factor, and not to cross-load >.3, in order to contribute to a factor. The first factor was found to consist of all five DHQ_{aud} items identified by Jones et al. (2009). The second factor was made up of all four original DHQ_{pres} items identified by Jones et al. (2009), plus two visual H&H items (items 3 & 9). The confirmatory factor analysis thus failed to replicate the previously identified three-factor structure of the DHQ due to the visual and felt-presence items not forming distinct factors.

As the original DHQ_{aud} and DHQ_{pres} items loaded most strongly onto the two factors identified, we reanalysed the DHQ data after excluding all visual H&H items. An exploratory factor analysis found two eigenvalues over 1 (3.54, 2.08) which explained 62.48% of the variance. Kaiser's rule, scree plot analysis, and a parallel analysis using a Monte Carlo analysis with 1000 repetitions, all suggested the extraction of two factors. These corresponded to the original DHQ_{aud} and DHQ_{pres} factors of Jones et al. (2009) with all items loading uniquely onto a single factor, and not cross-loading. The failure of DHQ_{vis} items to form a separate factor in the first analysis appeared to be a function of the lower prevalence of endorsement of DHQ_{vis} items relative to DHQ_{aud} or DHQ_{pres} experiences. Indeed, of the four items on the DHQ that over two-thirds of participants said they had never experienced, three were visual items. These findings suggest that the visual H&H items may best be used as non-scored filler items, not forming a distinct factor. For this reason our findings are henceforth given for solely the DHQ_{aud} and DHQ_{pres} subscales, and we refer to this alternate scoring system as the revised DHQ (DHQ-R).

The DHQ-R was then administered to the second sample ($N = 502$) to examine its psychometric properties. A confirmatory factor analysis was performed to test the DHQ-R's two-factor structure. As the DHQ_{aud} and DHQ_{pres} were non-normally distributed, fit was again adjudged using Bentler and Yuan's (1999) *F* statistic (T_F). Both one-factor, T_F (27, 475) = 6.26, $p < .001$ [χ^2_{ADF}(27) = 178.37, $p < .001$, GFI = .89, CFI = .61, RMSEA = .11 (90% CI = .09–.12)],and two-factor, T_F(26, 476) = 2.35, $p < .001$ [χ^2_{ADF}(26) = 64.38, $p < .001$, GFI = .96, CFI = .90, RMSEA = .05 (90% CI = .04–.07)] solutions were significantly different to the data. After allowing for correlated errors between error terms on the same factor (Byrne, Shavelson, & Muthén, 1989), as suggested by modification indices (items 5&6, 5&8 and 4&10), the two-factor solution was not significantly different to the data, T_F (23, 479) = 1.41, n.s. [χ^2_{ADF} (23) = 33.92, n.s., GFI = .98, CFI = .97, RMSEA = .03 (90% CI = .00–.05)].

The DHQ_{aud}, $\alpha = .81$, and the DHQ_{pres}, $\alpha = .85$, subscales showed satisfactory internal reliability. Both the DHQ_{aud}, r(114) =.71, $p < .001$, and the DHQ_{pres}, r(114) = .72, $p < .001$, showed satisfactory test–retest reliability.

2.3. Discussion of Study 1

The three-factor structure of the DHQ was not supported. The lower rate of endorsement of visual items, as compared to auditory or felt-presence items, was likely the reason for this. A revised version of the DHQ (DHQ-R) which retains, but does not score, visual H&H items was found to have a clear two-factor structure (auditory and felt-presence), with each of these subscales showing good internal and test–retest reliability. The DHQ-R hence appears to have superior psychometric properties to the original DHQ.

3. Study 2: Relation of modality of mental imagery to modality of H&H experiences

3.1. Method

3.1.1. Participants, measures and procedure

Data for Study 2 were obtained from the 299 university students who took part in the first phase of Study 1, who completed further on-line questionnaires as follows:

3.1.1.1. White Bear Suppression Inventory (WBSI; Wegner & Zanakos, 1994). In this 15-item self-report measure of tendency to suppress thoughts, each item is scored on a five-point Likert scale. Several factor analyses have confirmed that the WBSI measures both thought suppression and intrusive thoughts, and following Jones and Fernyhough (2006) two subscales of the WSBI were employed, intrusive thoughts ($WBSI_{intru}$) and thought suppression ($WBSI_{sup}$).

3.1.1.2. Hospital Anxiety and Depression Scale (HADS: Zigmond & Snaith, 1983). This 14-item scale consists of a seven-item anxiety subscale and a seven-item depression subscale. Items are scored on a four-point Likert scale, with higher scores (potential range 0–28) representing higher levels of anxiety/depression. This scale has been shown to have satisfactory psychometric properties (ibid).

3.1.1.3. Intrusive visual imagery (McCarthy-Jones, Knowles, & Rowse, in preparation). This 10-item scale assesses intrusive visual imagery. Items include "I have images in my mind that I cannot stop" and “I keep seeing events from my past in my mind’s eye, against my will”. Items are scored on a five-point Likert scale ranging from “Strongly agree” to “Strongly disagree”. Higher scores (potential range 10–50) represent higher levels of intrusive visual imagery. This tool has been found to have satisfactory internal and test–retest reliability (ibid).

3.1.1.4. Intrusive verbal imagery(McCarthy-Jones et al., in preparation). This 10-item scale specifically assesses intrusive verbal imagery. Items include “I have verbal thoughts in my mind that I cannot stop” and “There are some words or phrases that enter my head without me being able to avoid it”. Items are scored on a five-point Likert scale ranging from “Strongly agree” to “Strongly disagree”. Higher scores (potential range 10–50) represent higher levels of intrusive verbal thought. This tool has been found to have satisfactory internal and test–retest reliability (ibid).

3.2. Results

Descriptive statistics are presented in Table 1. Correlational analyses are presented in Table 2. The specificity of intrusive thought modality to DHQ_{aud} was investigated using multiple linear regression. DHQ_{aud} was entered as the dependent variable, with age, gender, anxiety, depression, and $WBSI_{sup}$ entered in the first step, and intrusive visual imagery, intrusive verbal imagery, and the mean-centred interactions between intrusive verbal imagery $\times$ anxiety, intrusive verbal imagery $\times$ depression, intrusive visual imagery $\times$ anxiety, and intrusive visual imagery $\times$ depression, entered in a second step. The first step was significant, $F(5,293) = 3.34$, $R^2 = .05$, $p < .01$. The second step was also significant, $\Delta F\ (6,287) = 4.43$, $\Delta R^2 = .08$, $p < .001$, with the overall model also being significant, $F(11,287) = 4.04$, $R^2 = .13$, $p < .001$. The only significant predictor in the final model was intrusive verbal imagery score, $\beta = .30$, $p < .001$.

These analyses were then repeated with DHQ_{pres} as the dependent variable. The first step was significant, $F(5,293) = 6.94$, $R^2 = .10$, $p < .001$, as was the second step, $\Delta F\ (6,287) = 6.84$, $\Delta R^2 = .06$, $p < .01$, with the overall model also being significant, $F(11,287) = 5.25$, $p < .001$. The only significant predictor in the final model was intrusive visual imagery scores, $\beta = .24$, $p < .01$.

Table 1
Descriptive statistics ($N = 299$).

Variable	Mean (SD)	Internal reliability (α)
DHQ_{aud}	4.59 (4.54)	.80
DHQ_{pres}	4.16 (4.34)	.85
$WBSI_{sup}$	33.91 (6.79)	.83
Intrusive verbal imagery	19.55 (8.40)	.90
Intrusive visual imagery	20.61 (7.59)	.87
$HADS_{anxiety}$	8.19 (4.07)	.82
$HADS_{depression}$	4.25 (3.26)	.71

3.3. Discussion of Study 2 and general discussion

Multiple linear regression analyses showed that the only predictor of auditory H&H hallucinations was intrusive auditory imagery. This supports a model in which intrusive auditory imagery occurring in the H&H state comes to be experienced as auditory hallucinations. This builds on existing cognitive models of auditory hallucinations in patients with psychosis, where intrusive thoughts have been linked to auditory verbal hallucinations (Morrison & Baker, 2000). Such intrusive thoughts in the H&H state may be experienced as non-self-produced, due to the low cognitive effort associated with such experiences resulting in source-monitoring errors (Bentall, 1990). However, the relatively small amount of variance accounted for by intrusive verbal imagery (13%) suggests that other important factors are also involved.

At first glance, the finding that intrusive visual imagery predicted felt-presence H&H experiences is puzzling, given that the latter are defined in terms of having no visual or other perceptual component. A possible explanation is that imagery is associated with a greater amplification of affect compared to verbal thought. For example, visualising negative scenarios has been shown to increase negative affect to a greater degree than simply reading such scenarios and focusing on the words and their meaning (Holmes, Mathews, Dalgleish, & Mackintosh, 2006). The amplification of affect by the use of such imagery may lead to hypervigilance and trigger felt-presence experiences.

There were a number of limitations to this study. Firstly, the study employed a retrospective self-report measure. Other methodologies, such as diary reports, may give a more accurate measure of the frequency of H&H experiences. The diary method is commonly used in dream research, and its application to H&H phenomena would likely be fruitful. Secondly, the study was limited to a student population, suggesting the need to replicate these findings in a general population sample.

In terms of future research, intrusive thoughts in specific modalities have not yet been investigated in relation to hallucinations in clinical populations, such as individuals with psychosis. On the basis of our present findings, we would hypothesise that it is specifically intrusive auditory imagery that is associated with auditory verbal hallucinations, rather than intrusive visual imagery. If such links are found, it would raise the possibility that cognitive behavioural therapy could be modified to focus more on the specific modality of thoughts that are related to hallucinations. In terms of H&H hallucinations, it still remains to be established whether coping strategies for such experiences may be transferable to patients with psychosis. Finally, extending our work, it may also be considered whether, in other conditions such as post-traumatic stress disorder, there is a concordance between the modality of intrusive thoughts of trauma when awake, and the modality of imagery experienced in dream anxiety when asleep.

Table 2
Partial correlations (controlling for age and gender, $N = 299$).

	DHQ_{aud}	DHQ_{pres}	$WBSI_{sup}$	IIVis	IIVerb	HADS anxiety	HADS depression
DHQ_{aud}	1	.27*	.05	.18	.31*	.18	.21*
DHQ_{pres}	–	1	.16	.33*	.24*	.31*	.26*
$WBSI_{sup}$	–	–	1	.54*	.45*	.50*	.34*
Intrusive visual imagery	–	–	–	1	.58*	.53*	.37*
Intrusive verbal imagery	–	–	–	–	1	.48*	.40*
$HADS_{anxiety}$	–	–	–	–	–	1	.65*
$HADS_{depression}$	–	–	–	–	–	–	1

* $p < .001$ (i.e., ~.05/21).

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