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In a dark time: Development, validation, and correlates of the Durham hypnagogic and hypnopompic hallucinations questionnaire

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ABSTRACT

One factor limiting research involving hypnagogic and hypnopompic (H&H) hallucinations is the lack of a brief, valid and reliable self-report measure of such experiences. The present paper reports on the development of the Durham Hypnagogic and Hypnopompic Hallucinations Questionnaire (DHQ), which consists of three unidimensional subscales assessing the presence of auditory, visual, and felt-presence experiences in the H&H state. In a sample of 18–29 year olds ($N = 365$) this scale was found to have satisfactory psychometric properties. A subsample ($n = 293$) completed self-report measures of intrusive thoughts, thought suppression and transliminality. Intrusive thoughts and the conscious desire to undertake thought suppression both correlated with levels of auditory, but not visual or felt-presence H&H hallucinations. Transliminality correlated with all DHQ subscales, but significantly more strongly with felt-presence than visual H&H experiences. Implications of these findings are considered, and recommendations for future research made.

1. Introduction

Hallucinatory experiences on the borders of sleep affect the majority of individuals (Ohayon, 2000). Hypnagogic (experienced in the wake–sleep transition) and hypnopompic (experienced in the sleep–wake transition) hallucinations may occur across the spectrum of sensory modalities, including the visual, tactile, and olfactory. They may also involve feelings of a presence that cannot be heard, felt, seen or smelt. Following Mavromatis' (1987) argument that no clear phenomenological or physiological differences exist between hypnagogic and hypnopompic (henceforth H&H) hallucinations, we treat them here as belonging to the same group of phenomena. Leaning (1925) noted that H&H states were a 'little cultivated area' (p. 290), and today we still know relatively little about the correlates of H&H experiences (Watson, 2001).

One factor limiting research into such experiences is the absence of a brief, psychometrically reliable and valid self-report measure. Cheyne and colleagues (e.g., Cheyne & Girard, 2007) have developed a valuable tool to assess H&H hallucinations (the Waterloo Unusual Sleep Experiences Survey), which incorporates both qualitative and quantitative responses. This instrument was not designed, however, to have internally reliable subscales assessing the presence of H&H experiences in each modality, and is also time consuming for participants to complete. The first aim of the present study was hence to establish a brief, valid and reliable measure of auditory, visual, and felt-presence H&H experiences. The development of such a tool, suitable for inclusion with a battery of other psychometric assessments, should help enable specific hypotheses in this area to be tested, such as whether levels of H&H experiences prospectively predict psychosis or near-death experiences (Jones & Fernyhough, in press).

Our second aim was to investigate factors potentially associated with H&H experiences. Many theories of H&H hallucinations model these as intrusions from REM sleep (Hori, Hayashi, & Morikawa, 1994). Such theories can be seen to share some commonalities with so-called 'seepage' models of hallucinations, in which hallucinations occur due to material crossing a boundary from the unconscious to the conscious (e.g., West, 1962). We proposed that general susceptibility to intrusions would relate to H&H experiences. A number of ways of assessing and conceptualizing individual differences in susceptibility to such incursions exist. One important such concept is that of transliminality (Thalbourne & Delin, 1994). Transliminality has been defined as the 'extent to which the contents of some preconscious (or 'unconscious' or 'subliminal') region of the mind are able to cross the threshold into consciousness' (Thalbourne & Delin, 1994, p. 3). We hence firstly hypothesized that transliminality would relate positively to individuals' susceptibility to H&H experiences.

Another way to conceptualize intrusions into consciousness is through the paradigm of intrusive thoughts. The intrusive occurrence of thoughts has been linked to auditory hallucinations in

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the waking state in clinical and non-clinical populations (Jones & Fernyhough, 2006; Morrison & Baker, 2000). However, less research has considered how intrusive thoughts relate to hallucinations in other modalities, or proposed a theoretical basis for such a relation. Our second hypothesis was hence that the tendency to experience intrusive thoughts in the waking state would be positively associated with higher levels of auditory, but not visual or felt-presence H&H experiences.

If, as hypothesized, intrusive thoughts are associated with auditory H&H experiences, cognitive strategies that encourage the occurrence of intrusive thoughts should also be linked to auditory H&H phenomena. One such strategy is likely to be thought suppression, defined as 'the intentional conscious removal of a thought from subsequent conscious attention' (Wegner, 1992, p. 194). Due to its potential to create intrusive thoughts, thought suppression has been linked with auditory hallucinations in healthy populations in clear consciousness (Jones & Fernyhough, 2006). Suppression of a thought also makes it more likely to occur in an H&H hallucination (Schmidt & Gendolla, in press). It therefore seems plausible that trait levels of thought suppression should be linked to the occurrence of auditory H&H phenomena, through its encouragement of cognitive intrusions. Our third hypothesis was thus that levels of thought suppression would be associated with auditory, but not visual or felt-presence, H&H experiences.

In summary, the present study set out to develop a brief, valid, and reliable self-report questionnaire for assessing H&H experiences. We hypothesized firstly that levels of transliminality would be positively associated with all forms of H&H experiences. Our second and third hypotheses were that auditory, but not visual or felt-presence H&H experiences would be associated with the self-reported tendencies both to experience intrusive thoughts and to undertake thought suppression.

2. Method

2.1. Participants

A first sample of students ($N = 399$, 215 women) at a United Kingdom University, with a mean age of 19.5 years (SD = 1.1, range = 18–24) completed a 25-item, on-line H&H experiences questionnaire. Participants were recruited through e-mail invitation. There was no financial incentive to participate. Answers were given anonymously, with only age and gender being requested.

A second, separate sample of students ($N = 365$, 236 women) with a mean age of 21.1 years (SD = 2.8, range = 18–29) completed a revised 14-item version of the original H&H questionnaire. This 14-item questionnaire was named the Durham Hypnagogic and Hypnopompic Hallucinations Questionnaire (DHQ). Issues around recruitment, lack of financial incentive and anonymity of responses were the same as for the first sample. Of this sample, 293 (195 women) with a mean age of 21.1 years (SD = 2.8, range 18–29) consented to go on to complete the questionnaire measures detailed below.

Response rates were approximately 20%, and comparable to previous studies employing on-line questionnaires of similar length (e.g., Kaplowitz, Hadlock, & Levine, 2004). On-line questionnaires have been shown to be a reliable method of data collection (e.g., Jones, Fernyhough, de-Wit, & Meins, 2008).

2.2. Measures

Measures employed included those described below. The development of the DHQ is detailed in Section 3.1.1.

White Bear Suppression Inventory (WBSI; Wegner & Zanakos, 1994): This inventory is a 15-item self-report measure of tendency to suppress thoughts. Each item is scored on a five-point Likert scale ranging from 'strongly agree' (5) to 'strongly disagree' (1). Muris, Merckelbach, and Horselenberg (1996) argued that the WBSI taps intrusive thoughts as well as thought suppression, and devised a 'corrected WBSI' (p. 505) which removed all items relating to intrusion (items 2, 3, 4, 5, and 9). The resultant scale ($WBSI_{sup}$) was found to have satisfactory internal reliability and test–retest reliability, and was used in the present study as a measure of self-reported thought suppression. Following Muris et al. (1996), numerous factor analyses have confirmed the WBSI measures both thought suppression and intrusive thoughts. A range of studies (see Jones & Fernyhough, 2006) all identified subtly different 'unwanted intrusive thoughts' factors of the WBSI, all finding the core items Muris et al. (1996) identified as the 'intrusion items' on the WBSI (items 2, 3, 4, 5 and 9) to load onto this factor. Thus, we used these five items as a separate measure of self-reported intrusiveness of unwanted thoughts ($WBSI_{intru}$).

Hallucination-proneness: This was assessed using the revised Launay–Slade hallucination scale (Bentall & Slade, 1985), a 12-item instrument designed to measure predisposition to hallucination-like experiences. Each item is scored on a five-point Likert scale ranging from 'certainly applies to me' (0) to 'certainly does not apply to me' (4). Higher scores indicate a greater predisposition to hallucination-like experiences. This tool has been found to have satisfactory psychometric properties (ibid.). In the current administration, it was stated at the start that participants should only endorse items if they had experienced them in clear consciousness, and not in the H&H state.

Transliminality: This was assessed using the 17-item scoring scheme (Lange, Thalbourne, Houran, & Storm, 2000) for the 29-item transliminality scale (Thalbourne, 1998). Scores can range from 13.7 to 37.3, with higher scores representing higher levels of transliminality. Response options are 'true' or 'false'. Examples of items are 'I have felt that I had received special wisdom, to be communicated to the rest of humanity' and 'I think I really know what some people mean when they talk about mystical experiences'. The validity and reliability of this scale has previously been demonstrated (ibid).

3. Results

3.1. Durham Hypnagogic Hallucinations Questionnaire

3.1.1. Development of the DHQ

A preliminary 25-item questionnaire assessing the presence of auditory, visual, and felt-presence H&H hallucinations was developed through face-to-face discussions with students, an Internet search for accounts of such experiences, and integration of features of the categories used by Cheyne and Girard (2007). Preliminary instructions make it clear to participants that items should only be endorsed if they have been experienced in the H&H state. These instructions read: "in the drowsy state when you are about to fall asleep, or have just woken up, healthy people can experience hallucination-like experiences. We are interested in whether you have any experiences like this. There are a number of statements below about such experiences, please indicate if you have had such experiences or not. To be clear, all the statements refer to experiences you may have had on the border of falling asleep or waking up, and which could not have had a source in the 'real world'. For example, the item 'I have seen a blurry figure in the room' refers to seeing a blurry figure when you were about to fall asleep or wake up, which you later realised was not really there, although at the time it seemed real". Response options (and scoring) were on a 6-point Likert scale: 'never' (0), 'very rarely' (1), 'rarely' (2), 'occasionally' (3), 'frequently' (4), and 'very frequently' (5).

This questionnaire was administered to a first set of participants ($N = 399$). Initial exploratory factor analysis was then performed using principal components analysis (PCA) with oblique rotation (Direct Oblimin) on the basis that factors were likely to correlate with each other. The Kaiser-Meyer-Olkin measure of sampling adequacy was .89, and Bartlett's test of sphericity was significant ($p < .001$). Items were discarded if over 85% of participants indicated they had never had the experience, the item communality was <.4, or if feedback indicated problems with the wording. This led to eleven items being discarded, including 'I have heard animal noises', and 'I have seen someone I know to be dead'. A further PCA was then performed on the remaining fourteen items.

Scree-plot inspection, Kaiser's rule, and parallel analysis using a Monte Carlo analysis with 1000 repetitions all suggested the extraction of three-factors, with eigenvalues of 5.67, 1.69, and 1.21, accounting for 61.23% of the observed variance. Each item loaded (>.5) onto a single factor. The three-factors clearly related to auditory H&H hallucinations, visual H&H hallucinations, and the experience of a felt-presence.

The 14-items identified above, modified after feedback from participants, were administered to a new sample ($N = 365$), and constituted the final version of the DHQ (Table 1). Confirmatory factor analysis was performed on the data using AMOS 6.0, in order to examine if a three-factor solution, consisting of auditory (DHQ_{aud}: items 2, 5, 6, 8, and 12), visual (DHQ_{vis}: items 3, 7, 9, 11, and 13) and felt-presence (DHQ_{pres}: items 1, 4, 10, and 14) H&H factors, was a good fit to the data. Previous psychometric research has demonstrated that in order to generate a well-fitting model, it may be necessary to allow for correlated errors (Byrne, Shavelson, & Muthén, 1989). Byrne et al. (1989) have noted that 'such parameter specifications are justified because, typically, they represent nonrandom measurement error due to method effects such as item format associated with subscales of the same measuring instrument' (p. 460). We hence hypothesized that it may be necessary to allow errors of some items on the same DHQ subscale to correlate in order to achieve a satisfactory fit.

As the data was non-normal, initial analysis was performed using the asymptotically distribution free (ADF) method. However, this performs poorly for samples of the size employed here (Bentler & Yuan, 1999). We hence adjudged fit using Bentler and Yuan's (1999) F statistic (T_F), a modification of the ADF statistic which performs well with non-normal data in sample sizes as low as 90. Other goodness of fit indices (such as GFI, CFI, and RMSEA) depend on the choice of estimation method. As AMOS 6.0 is unable to recalculate such goodness of fit statistics for use of the T_F estimation method, we were only able to report such statistics for the ADF method. As shown below, the more appropriate T_F statistic often suggested better model fit than the ADF statistic, and hence the GFI, CFI, and RMSEA fit statistics reported below, based on the ADF statistic, are likely to be underestimates.

The standard minimum fit chi-squared was a poor fit to the data, $\chi^2_{ADF}(91) = 536.64, p < .001$. Similarly, a one-factor solution was found to differ significantly from the data, $T_F(77, 288) = 2.28$, $p < .001$ [$\chi^2_{ADF}(77) = 222.80$, $p < .001$, GFI = .79, CFI = .67, RMSEA = .07 (90% CI = .06–.08)]. The proposed three-factor solution also differed significantly from the data, $T_F(74, 291) = 1.51$, $p < .01$ [$\chi^2_{ADF}(77) = 794.40$, $p < .001$, GFI = .87, CFI = .82, RMSEA = .05 (90% CI = .04–.06)]. As hypothesized, modification indices indicated that the 3-factor solution would be improved by allowing errors for a number of similar items from within the same subscale (specifically DHQ items 3 and 13, 2 and 6, 5 and 6, and 2 and 8) to correlate. The resultant model did not differ significantly from the data, $T_F(70, 295) = 1.24$, n.s. [$\chi^2_{ADF}(77) = 107.53$, $p < .001$, GFI = .90, CFI = .92, RMSEA = .04 (90% CI = .04–.06)]. In this model standardized regression weights ranged from .69 to .88, and correlations between the factors ranged from .65 to .71.

Finally, Rasch analysis (one-parameter item response theory) was performed to determine whether each DHQ subscale was unidimensional. Rasch analysis places questionnaire response data for

Table 1
Endorsement rates for DHQ items ($N = 365$)

Item	Mean (SD)	Percentage (%) of people endorsing			
		Never	Rarely or very rarely	Occasionally	Frequently or very frequently
1. I've felt an evil presence in the room, but could not see, hear, touch or smell anyone there	.88 (1.24)	58	24	15	3
2. I've heard someone calling my name	1.11 (1.35)	51	26	18	5
3. I've seen a blurry human figure in the room	.84 (1.24)	60	24	12	4
4. I've had the sense of an invisible presence watching me	1.16 (1.38)	48	31	14	7
5. I've heard the voice of a person I could not identify	.65 (1.13)	69	20	9	3
6. I've heard human speech which spoke in a garbled, unclear way	.56 (1.11)	74	16	7	3
7. I've seen the image of a face	.71 (1.19)	67	21	8	4
8. I've heard a voice of a person familiar to me	.99 (1.34)	56	26	12	6
9. I've seen things or figures floating in my room	.49 (1.05)	77	15	4	4
10. I've felt the presence of an intruder in my bedroom, though I did not actually see, hear, touch, or smell anyone	.94 (1.30)	55	28	12	6
11. I've clearly seen people in my room	.33 (.87)	84	9	4	2
12. I've heard non-speech sounds, such as laughter, music, or other noises	.78 (1.18)	62	26	8	4
13. I've seen things in my room other than people	.56 (1.11)	73	18	5	4
14. I've had the feeling of a presence in the room which I felt was aware of me too, but I could not actually see, hear, touch or smell them	.79 (1.18)	60	28	9	3

each individual and each question on the same spectrum of person severity and item severity. The Rasch model (Rasch, 1960) assumes that the probability that a particular individual will respond in a certain way to a particular item is a function of the relative distance between the item and person severity and only a function of this. Analyses were conducted using the Rasch Unidimensional Measurement Model (RUMM2020; Andrich, Lyne, Sheridan, & Luo, 2003) software. The adequacy of DHQ scale fit to the Rasch model was evaluated using the item-trait interaction χ^2 fit statistic, and item fit was evaluated through individual item χ^2 fit statistics. Significant statistics ($p < .01$ given the large number of tests completed) indicate misfit to the Rasch model. Item fit residuals were also examined and a final test conducted within the RUMM framework to confirm the absence of multi-dimensionality in each scale. Differential Item Functioning (DIF; Holland & Wainer, 1993) by gender was also examined to determine whether responses to DHQ items were significantly influenced by the gender of the respondent.

Each of the final DHQ subscales exhibited fit to the Rasch model (χ^2, $p > .01$) with no individual items exhibiting misfit (χ^2, $p > .01$) or excessive residuals (<±2.5). In addition, no item was subject to DIF by gender (ANOVA $p < .01$). The tests for multi-dimensionality indicated that the three DHQ scales are in fact unidimensional. Although the combined 14-items of the DHQ fit the Rasch model these additional tests indicated that they could not be considered to capture a unidimensional construct.

3.1.2. Pattern of responses to the DHQ

Mean (SD, range) DHQ scores were DHQ_{aud} = .83 (.99, 0–4.6), DHQ_{vis} = .58 (.81, 0–4.2), and DHQ_{pres} = .95 (1.09, 0–4.5). Paired *t*-tests (with a Bonferroni-corrected alpha of $\alpha = .02$) showed that both mean DHQ_{pres} and DHQ_{aud} subscale scores were higher than mean DHQ_{vis} subscale scores, $t(364) = 7.78$, $p < .001$, and $t(364) = 5.49$, $p < .001$, respectively. Mean DHQ_{aud} and DHQ_{pres} scores did not differ.

Eighty-five percent of participants reported experiencing at least one of the items on the DHQ. Sixty-seven percent of participants endorsed at least one item on the DHQ_{pres}, with the equivalent rates being 65% and 58% for the DHQ_{aud} and DHQ_{vis}, respectively. Typically, around 5% of participants experienced frequent or very frequent H&H experiences. The most common items in each modality were hearing one's name called, seeing a blurry figure in the room, and the feeling of an invisible presence watching. There were no gender differences in scores on any of the DHQ subscales, or at item level when Bonferroni corrections were employed.

3.1.3. Reliability and validity of the DHQ

Cronbach's alphas for all DHQ subscales were satisfactory (Table 2). Face validity of the DHQ was maximized by developing the original questionnaire items from accounts of such experiences. Convergent validity of the DHQ was evaluated by its correlation with the revised Launay–Slade hallucination scale. Given that (regardless of frequency of occurrence) approximately 50% of people who report daytime hallucinations also experience H&H hallucinations (Ohayon, 2000), we expected that hallucinatory experiences in the H&H state would be related to the more general tendency to experience hallucinatory experiences. In line with this, a positive correlation was found between the LSHS-R and all subscales of the DHQ (Table 3).

3.2. Intrusion-proneness and H&H experiences

Descriptive statistics for the participants ($n = 293$) who went on to complete further questionnaires are given in Table 2. LSHS-R, $WBSI_{sup}$ and $WBSI_{intru}$ scores were in line with previous studies assessing these variables in student populations (e.g., Jones & Fernyhough, 2006). Bivariate correlational analyses are presented in Table 3. Bonferroni-corrected significance levels were employed and alpha set at $p = .001$ (i.e., ∼.05/28). Transliminality correlated significantly with all DHQ subscales. DHQ_{pres} correlated more strongly with transliminality than DHQ_{vis}, $\chi^2 = 4.94$, $p < .05$, but not significantly differently to DHQ_{aud}. Intrusive thoughts and thought suppression both correlated significantly with DHQ_{aud}, but not with any other DHQ subscales.

Table 2
Descriptive statistics ($n = 293$)

	Mean (SD, range)	Cronbach's alpha
DHQ_{aud}	.82 (.99, 0–4.6)	.86
DHQ_{vis}	.59 (.83, 0–4.2)	.82
DHQ_{pres}	.93 (1.08, 0-4.5)	.87
$WBSI_{intru}$	18.32 (4.14, 6–25)	.80
$WBSI_{sup}$	34.26 (8.43, 10–50)	.87
Transliminality	22.21 (3.66, 13.7–35.0)	.75
LSHS-R	18.21 (9.24, 0–42)	.85

4. Discussion

The research reported here represents the first attempt to produce a brief, psychometrically reliable and valid self-report measure of H&H phenomena. Exploratory and confirmatory factor analysis indicated that the resulting instrument, the DHQ, had a three-factor structure, indexing auditory H&H hallucinations, visual H&H hallucinations, and the experience of a felt-presence. Rasch analysis confirmed that each of these scales was unidimensional and therefore capable of generating summed total scores. The reliability and validity of this tool were satisfactory, with the DHQ subscales being found to be internally reliable and to have both face and convergent validity.

Each subscale of the DHQ had at least one item endorsed by approximately two-thirds of participants, with only 15% of participants reporting never having experienced any of the items on the DHQ. The resulting prevalence rate of H&H phenomena of 85% is significantly higher than the 31% rate (in a 15–44 year age group) of hypnagogic hallucinations reported by Ohayon (2000) but consistent with the rates of hypnagogic (79%) and hypnopompic (72%) imagery (in a 20–29 year old student sample) reported by Richardson, Mavromatis, Mindel, and Owens (1981). One possible reason for this disparity in prevalence is that Ohayon's methodology, which involved collecting data via telephone interviews whilst also asking about mental illnesses, may have led to reduced disclosure. Another possible reason is that the frequency of H&H experiences is positively related to levels of drug use (Ohayon, 2000), and drug use is higher in student populations than in the general population (Hope, Dring, & Dring, 2005). Finally, Ohayon does not report the question(s) used to assess the presence of H&H experiences. If Ohayon only utilized a single question, the multiple-item DHQ could likely have generated higher endorsement rates due to its provision of specific examples of the relevant experiences.

Auditory and felt-presence H&H experiences were found to be more frequent than visual experiences. This is in contrast to the findings of Ohayon (2000) who found visual experiences to be more common than auditory or felt-presence experiences. No clear gender differences in DHQ responses were found, in contrast to previous findings that such experiences are more common in women than men (Ohayon, 2000; Richardson et al., 1981). We did however note that a number of items not included in our final version of the DHQ, such as 'Have you ever felt a benevolent, protecting figure?' were significantly more often endorsed by women than

Table 3
Bivariate correlational analysis

	DHQ_{aud}	DHQ_{vis}	DHQ_{pres}	$WBSI_{intru}$	$WBSI_{sup}$	Transliminality	LSHS-R
DHQ_{aud}	1	.56*	.46*	.27*	.23*	.35*	.50*
DHQ_{vis}	–	1	.58*	.16	.11	.28*	.43*
DHQ_{pres}	–	–	1	.11	.14	.44*	.38*
$WBSI_{intru}$	–	–	–	1	.65*	.35*	.54*
$WBSI_{sup}$	–	–	–	–	1	.28*	.35*
Transliminality	–	–	–	–	–	1	.50*
LSHS-R	–	–	–	–	–	–	1

* $p < .001$

men. Future studies may wish to consider whether gender differences are only found in relation to specific H&H content.

Our study also aimed to examine the relation between cognitive intrusions and H&H experiences. In line with our first hypothesis, transliminality was positively related to all subscales of the DHQ. We found support for our second and third hypotheses that auditory (but not visual or felt-presence) H&H experiences would be associated with the self-reported susceptibility to intrusive thoughts and tendency to undertake thought suppression. Although a weak correlation, this could be taken to suggest that different explanatory models are needed for each modality of H&H phenomena.

A number of limitations of the present study need to be acknowledged. Firstly, the forgetting or elaboration of hypnagogic experiences may affect responses on the DHQ. Secondly, in order to achieve satisfactory internal consistency, the visual H&H factor of the DHQ is weighted towards experiences involving people, with less emphasis on experiences such as seeing lights, landscapes, and animals. Thirdly, the DHQ does not distinguish between experiences in the hypnagogic and hypnopompic states. In order to address this, the DHQ could be administered to a sample of participants twice, with instructions relating to hypnagogic and hypnopompic experiences in each instance. Another potential limitation is that the DHQ does not make a distinction between H&H hallucinations associated with sleep paralysis and those not. Future studies may also wish to establish the discriminant validity of the DHQ, as well as its test–retest reliability.

In addition to the broad categories assessed here (auditory, visual, and felt-presence H&H experiences), future researchers may also wish to consider a multi-dimensional conception of H&H phenomena. It would be of particular interest to examine what factors affect the content of the experiences, the distress caused by them, and the individual's conviction about their reality. Furthermore, it may be asked what factors differentiate individuals who experience a primarily benevolent felt-presence from those whose experience is primarily of an evil presence. Trauma may be one candidate. Future research may also consider the phenomenological relation of H&H hallucinations to those that occur in clear consciousness. Additionally, the DHQ could be used in samples at high risk for schizophrenia to examine if it predicts onset of this disorder. It is hoped that the present study will be seen as a step towards allowing greater understanding of the causes, correlates and consequences of this intriguing phenomenon.

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