JNMD 189, 190-192.

Ross CA (1997). *Dissociative identity disorder: Diagnosis, clinical features, and treatment of multiple personality.* New York: Wiley.

Sanders B, Giolas MH (1991) Dissociation and childhood trauma in psychologically disturbed adolescents. *Am J Psychiatry* 148:50–54.

Snow MS, Beckman D, Brack G (1996) Results of the Dissociative Experiences Scale in a jail population. *Dissociation* 9:98–103.

Van IJzendoorn MH, Schuengel C (1996) The measurement of dissociation in normal and clinical poplations: Meta-analytic validation of the Dissociative Experiences Scale (DES). *Clin Psychol Rev* 16:365–382.

Wilson BA, Alderman N, Burgess PW, Emslie HE, Evans JJ (1996) *Behavioural assessment of the dysexecutive syndrome.* Bury St. Edmunds, England: Thames Valley Test Company.

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Transliminality, Brain Function, and Synesthesia

Transliminality is a "hypothesized tendency for psychological material to cross thresholds into or out of consciousness" (Thalbourne and Houran, 2000, p. 861). This construct was already anticipated as early as William James (1902/1982), but it was only recently given empirical definition and attempted measurement by Thalbourne (1998) in terms of a 29-item dichotomous scale. Representative items from the scale are available in previous publications (Thalbourne, 1999, 2000a). It is important to note that these 29 test-items, which share a common underlying factor, span nine domains: hyperesthesia, (fleeting) hypomanic or manic experience, fantasy-proneness, absorption, creative personality, positive (and perhaps obsessional) attitude toward dream interpretation, mystical experience, paranormal belief and experience, and magical thinking. Consequently, the type of psychological material crossing into conscious awareness involves large amounts of imagery, ideation, and affect. Elsewhere (Houran and Thalbourne, 2001, in press), we have speculated about the neuropsychological basis of transliminality. Because transliminal experience resembles and positively correlates with schizotypal and schizophrenic-like experience (Thalbourne, 1998; Thalbourne et al., 1997), it may be that similar processes are operating.

A Neuropsychological Basis for Transliminality

Traditionally, schizotypal and schizophrenic-like experience have been conceived as a deficit in cognitive inhibition, or in selective attention tasks, in that the cognitive mechanisms responsible for active suppression (or gating) of irrelevant information from conscious awareness are defective, *i.e.*, weak or erratic (Braff et al., 1999; Lieb et al., 1996; Perry et al., 1999; Peters et al., 2000; Swerdlow and Geyer, 1998; Williams and Beech, 1997). Houran and Thalbourne (in press a, in press b) attribute this poor gating to a much greater degree of "interconnectedness" or "fluidity" in the brains of highly transliminal persons—the gateways that normally operate to regulate conscious and unconscious processing may be open to an unusually high degree. Neurological interconnectedness is necessary for psychological integration, but integration will be compromised (Nasrallah, 1985) when the interconnectedness is too liberal (O'Kusky et al., 1988; Witelson, 1985).

Modern-day behavioral scientists eschew the term "ego," owing to its psychoanalytic origin, but "ego" and "ego strength" have been used purely to describe cognitive functions and personality characteristics (Alias, 1974, 2000; Perry et al., 1995; Stone, 1980). Ego may be viewed as the central "magnetic sphere" of the psyche that integrates and coordinates the autonomous cognitive fragments consisting of "percept units" and (reactive and nonreactive) "thought units" (Alias, 1974), and ego strength as the centripetal, cohesive force with which the integration and coordination of the cognitive fragments are prosecuted (Alias, 2000). Kaplan and Sadock (1998) write, "first described by Herman Nunberg in 1931, the synthetic function refers to the ego's capacity to integrate diverse elements into an overall unity. . . [It] involves organizing, coordinating, and generalizing or simplifying large amounts of data" (p. 218). Freeman (1960) proposed that damage to the perceptual system of ego leads to a failure of its screening function. As a result the individual can no longer insulate a train of thought from extraneous sensory stimulation (*i.e.*, deficient sensorimotor gating: Braff et al., 1999; Perry et al., 1999; Swerdlow and Geyer, 1998). Percepts and images now compete for attention with already existing thoughts.

Alias (1974) hypothesized that a train of thought is an orderly linked chain made up of different autonomous units like amino aids in a protein molecule; the correct position of any unit, as well as the pace with which these units enter into consciousness for the organization of a stream of thought, is directed by the ego; this operation is largely automatic, instantaneous and without subjective awareness. If the ego is weak, as in schizotypy and schizophrenia, this arrangement becomes impaired and the "thought units" will "express" themselves, their independent existence, often in a disordered fashion (loose associations) either individually, or more collectively, to a highly variable extent depending upon the degree of ego-weakening, anxiety level, learning (by conditioning), and the state of arousal.

Andreasen et al. (1998) coined the term, "cognitive dysmetria," meaning "difficulty in prioritizing . . . coordinating, and responding to information." They postulated that a disruption in the circuitry among nodes located in the prefrontal regions, the thalamic nuclei, and the cerebellum produces cognitive dysmetria. This poor "mental coordination" is a fundamental cognitive deficit in schizophrenia and can account for its broad diversity of symptoms (Andreasen et al., 1998). A similar pathophysiology was proposed in connection with the schizophrenia-like episodes of temporal lobe epilepsy. Again, a broad range of interictal symptoms,

from the experience of supernormal states of awareness to a preoccupation with religious and cosmological ideas, was suggested to be a consequence of a hyperconnectivity between temporal-limbic structures and sensory association cortex (Bear, 1979). Cognitive dysmetria may also be viewed as an end-result of "ego-weakening" (Alias, 2000).

An Expected Phenomenon of the Highly Transliminal Mind

Assuming that transliminality and schizophrenic-like experience are rooted in a similar pathophysiology, then high transliminals might be expected to show tendencies for the spontaneous experience of loose associations (*i.e.*, disinhibited "spreading activation" in semantic networks allows establishment of nonstandard, "uncommon," "original" associations and ideas, such as found in people with strong schizotypal tendencies; see Duchêne et al., 1998). On a sensory level, this same disinhibition (reduced inhibition) leads to lower thresholds. Consequently, the "enhanced interconnectedness" that may underpin transliminality would promote a relative ease of switching between ideas and concepts. There is preliminary evidence that this switching or association involves sensory impressions and modalities as well. Specifically, Thalbourne (1996, Thalbourne et al., 1997) found that transliminality correlated with hyperesthesia (heightened sensitivity to sensory stimulation). Therefore, the enhanced interconnectedness in the brain that we believe regulates transliminality is not limited to frontal-subcortical loops or to a larger midsagittal area of the corpus callosum in those with greater bilaterality (Witelson, 1985) but also seems to involve high interconnectedness among primary or secondary sensory areas and/or sensory association cortices.

One prediction based on this theory of transliminality is that high transliminals would be prone to experience *synesthesia*, which Marks (2000, p. 121) described as the situation where "an inducing stimulus produces, at the same time, two kinds of sensory response: the primary sensory experience that is normally associated with that stimulus and, anomalously, a secondary experience in another modality," such as seeing a color in response to a sound. Our reasoning appears consistent with Abraham's (2000) conclusion that "Synesthesia . . . probably reflects heightened connectivity between adjacent cerebral regions" (p. 1018). We tested the hypothesized association between transliminality and synesthesia in two correlational studies.

Methods

Study 1 Participants. A total of 115 persons from the general Australian population were included, half of whom suffered from panic attacks, half of whom were their support-givers, who had taken part in a questionnaire experiment reported by Thalbourne et al. (1997: study V). Seventy-six were female, and 38 were male (1, no information). Age ranged from 18 to 73 years (mean = 39, SD = 11).

Materials. Materials included a) a factor score, derived from factor analysis of a larger sample, representing degree of transliminality; and b) a six-item synesthesia scale derived by Tellegen from the Absorption Scale (Tellegen and Atkinson, 1974).

Results. The Spearman rank correlation between scores on transliminality and synesthesia was .47 ($p < .001$).

Study 2 Participants. A total of 242 psychology students in the study by Thalbourne (1998) were included, all of whom had filled in the nine questionnaires from which the Transliminality Scale is derived; 175 were female, while 67 were male (one, no information). Age ranged from 17 to 63 years (mean = 25, SD = 10).

Materials. Materials included a) the 29-item Transliminality Scale, derived from the nine constituent scales used in its development; and b) Tellegen's previously mentioned six-item synesthesia scale.

Results. The Spearman rank correlation between scores on transliminality and synesthesia was .57 ($p < .001$).

Discussion

In both samples, taken from widely divergent sources, scores on Tellegen's Synesthesia Scale consistently showed moderate correlations with two measures of transliminality. We interpret these findings as consistent with the hypothesis that transliminality involves "enhanced interconnectedness" in the brain. However, we note two caveats. First, it could be argued that the correlation is artificially high because both the Synesthesia Scale and the Transliminality Scale contain overlapping items from the Absorption Scale. This is unlikely because the Transliminality Scale contains five items from the Absorption Scale, but none of these pertain to synesthesia. A second and more founded concern is the validity of our self-report measure of synesthesia. The incidence of synesthesia is estimated to be approximately 1 in 2000 individuals, with a genetic component (Groffman, 1999). Consequently, it is debatable whether our combined sample of 357 participants had any who experienced genuine synesthesia. Rather, we acknowledge that the six-item synesthesia measure derived by Tellegen from the Absorption Scale (Tellegen and Atkinson, 1974) probably addresses some forms of "pseudosynesthesia" as well, which includes artistic metaphor and experiencing synesthesia through drug use.

Research on the neurological basis for transliminality remains in the theoretical stage, but it is encouraging for the interconnectedness hypothesis to learn that high transliminals are likely also to report synesthetic-like experiences. On a more general level, we emphasize that poor neurological gating (or enhanced interconnectedness) in transliminals would not automatically elicit psychopathology as might be assumed from our introductory comments. Rather, Manfred Bleuler (1965) suggested that nearly all schizophrenic mechanisms can be found in normals, and the basic nature of schizophrenic psychopathology (Andreasen et al., 1998), such as associational loosening and poor ability to shift attention at will, has been conceived as a quantitative variation from a normal mean (Alias, 1974). Similarly, schizotypy is conceptualized as a personality continuum distributed within the general (nonclinical) population (Claridge, 1990, 1997). Therefore, clinical disorders may be comorbid conditions only for those extremely high in transliminality or for those who cannot cope well with transliminal experiences. It

is also understandable why high transliminals may use alcohol and illicit drugs to alleviate the subsequent experiences that can be disturbing in nature.[5]

The factors that mediate the degree of pathology for those high in transliminality have yet to be identified, but we anticipate that interactions among physiological, psychological, and social variables such as considered by Alias (1974) are involved. It is certainly possible that emotionally stable and well functioning high transliminals exist—their transliminal experiences (*e.g.*, synesthesia) being ignored, rationalized, or used as sources of inspiration for artistic and intellectual endeavors (*cf.* Thalbourne, 2000b). In this context, we recall a report on author Somerset Maugham experiencing a peculiar unpleasant taste in his mouth while engrossed in writing about one of his characters taking arsenic in a suicide scenario.

References

Abraham HD (2000) Hallucinogen-related disorders. In BJ Sadock, VA Sadock (Eds), *Kaplan and Sadock's comprehensive textbook of psychiatry* (7th ed; pp 1015–1025). Philadelphia: Lippincott Williams & Wilkins.

Alias AG (1974) On the psychopathology of schizophrenia. *Biol Psychiatry* 9:61–72.

Alias AG (2000) Schizotypy and leadership: A contrasting model for deficit symptoms, and a possible therapeutic role for sex hormones. *Med Hypotheses* 54:537–552.

Andreasen NC, Paradiso S, O'Leary DS (1998) 'Cognitive dysmetria' as an integrative theory of schizophrenia: A dysfunction in cortical-subcortical-cerebellar circuitry? *Schizophr Bull* 24: 203–218.

Bear DM (1979) Temporal lobe epilepsy: A syndrome of sensory-limbic hyperconnection. *Cortex* 15:357–384.

Bleuler M (1965) Conception of schizophrenia within the last 50 years and today. *Int J Psychiatry* 1:501–513.

Braff DL, Swerdlow NR, Geyer MA (1999) Symptom correlates of prepulse inhibition deficits in male schizophrenic patients. *Am J Psychiatry* 156:596–602.

Claridge G (1990) Can a disease model of schizophrenia survive? In RP Bentall (Ed), *Reconstructing schizophrenia* (pp 157–183). London: Routledge.

Claridge G (1997) Theoretical background and issues. In G Claridge (Ed), *Schizotypy: Implications for illness and health* (pp 3–18). Oxford: Oxford University Press.

Duchêne A, Graves RE, Brugger P (1998) Schizotypal thinking and associative processing: A response commonality analysis of verbal fluency. *J Psychiatry Neurosci* 23:56–60.

Freeman T (1960) On the psychopathology of schizophrenia. J *Ment Sci* 106:925–937.

Groffman S (1999) Seeing a sound, hearing a sight. *J Optometric Vision Dev* 30:177–180.

Houran J, Thalbourne MA (2001) Further study and speculations on the psychology of "entity encounter experiences." *J Soc Psychical Res* 65:26–37.

Houran J, Thalbourne MA (in press) Theoretical refinements on entity encounter experiences and transliminality. *J Soc Psychical Res.*

James W (1982) *The varieties of religious experience.* Harmondsworth, England: Penguin. (Originally published in 1902).

Kaplan HI, Sadock BJ (1998) *Kaplan and Sadock's synopsis of psychiatry* (8th ed). Baltimore: Williams & Wilkins.

Lieb K, Denz E, Hess R, Schuettler R, Kornhuber HH, Schrieber H (1996) Preattentive information processing as measured by backward masking and Textron detection tasks in adolescents at high genetic risk for schizophrenia. *Schizophr Res* 21:171–182.

Marks LE (2000) Synesthesia. In E Cardena, SJ Lynn, S Krippner (Eds), *Varieties of anomalous experience: Examining the scientific evidence* (pp 121–149). Washington, DC: American Psychological Association.

Nasrallah HA (1985) The unintegrated right hemispheric consciousness as alien intruder: A possible mechanism for Schneiderian delusions in schizophrenia. *Compr Psychiatry* 26:273–282.

O'Kusky J, Strauss E, Kosaka B, Wada J, Li D, Druhan M, Petrie J (1988) The corpus callosum is larger with right-hemisphere cerebral speech dominance. *Ann Neurol* 24:379–383.

Perry W, Geyer MA, Braff DL (1999) Sensorimotor gating and thought disturbance measured in close temporal proximity in schizophrenic patients. *Arch Gen Psychiatry* 56:277–281.

Perry W, McDougall A, Viglione DJ (1995) The Ego Impairment Index: A five-year follow up study. *J Pers Assess* 64:112–118.

Peters ER, Pickering AD, Kent A, Glasper A, Irani M, David AS, Day S, Hemsley DR (2000) The relationship between cognitive inhibition and psychotic symptoms. J *Abnorm Psychol* 109:386–395.

Stone M (1980) *The borderline syndromes.* New York: McGraw-Hill.

Swerdlow NR, Geyer MA (1998) Using an animal model of sensorimotor gating to study the pathophysiology and new treatments of schizophrenia. *Schizophr Bull* 24:285–301.

Tellegen A, Atkinson G (1974) Openness to absorbing and self-altering experiences ("absorption"), a trait related to hypnotic susceptibility. *J Abnorm Psychol* 83:268–277.

Thalbourne MA (1996) An attempt to predict precognition scores using transliminality-relevant variables. *J Soc Psychical Res* 61:129–140.

Thalbourne MA (1998) Transliminality: Further correlates and a short measure. *J Soc Psychical Res* 92:402–429.

Thalbourne MA (1999) Relation of transliminality and vividness of visual imagery. *Percept Mot Skills* 89:915–916.

Thalbourne MA (2000a) Relation between transliminality and openness to experience. *Psychol Rep* 86:909–910.

Thalbourne MA (2000b) Transliminality and creativity. *J Creative Behav* 34:193–202.

Thalbourne MA, Bartemucci L, Delin PS, Fox B, Nofi O (1997) Transliminality: Its nature and correlates. *J Am Soc Psychical Res* 91:305–331.

Thalbourne MA, Houran J (2000) Transliminality, the Mental Experience Inventory, and tolerance of ambiguity. *Pers Individ Diff* 28:853–863.

Williams L, Beech A (1997) Investigations of cognitive inhibitory processes in schizotypy and schizophrenia. In G Claridge (Ed), *Schizotypy: Implications for illness and health* (pp 63–79). Oxford: Oxford University Press.

Witelson SF (1985) The brain connection: The corpus callosum is larger in left-handers. *Science* 229:665–668.

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