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Personality and Individual Differences 38 (2005) 859–870

PERSONALITY AND INDIVIDUAL DIFFERENCES

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Season of birth variation in sensation seeking in an adult population

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Received 19 December 2003; received in revised form 5 May 2004; accepted 8 June 2004
Available online 12 August 2004

Abstract

Previous research has identified a relationship between season of birth and level of novelty seeking (Chotai, Lundberg, & Adolfsson, 2003). The current study investigates whether level of sensation seeking is also related to birth season in individuals from the Northern Hemisphere. Participants were 448 students of The Open University, UK (125 males, 323 females, age range 20–69 years, mean = 39.2, SD = 9.8). The Sensation Seeking Scale V and a demographic questionnaire including month of birth were completed by participants either on the World-Wide Web ($n = 284$) or on paper ($n = 164$). A significant interaction of age and season of birth on level of sensation seeking was found, similar to previous findings for novelty seeking. Individuals aged 20–45 years born during October to March had a higher level of sensation seeking than those of the same age born in the other six months, while the opposite association was found for individuals aged 46–69 years. Results suggest an age-related difference in level of sensation seeking between individuals born during different seasons. Possible reasons for the seasonal difference are discussed, including development of the sensation seeking trait across the lifespan in relation to dopamine turnover.

Keywords: Season of birth; Novelty seeking; Sensation seeking; Personality; Monoamines; Dopamine

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0191-8869/$ - see front matter
doi:10.1016/j.paid.2004.06.010

1. Introduction

The association between season of birth and a number of physical and psychiatric conditions among individuals in non-equatorial regions has been firmly established. For instance, adult life expectancy (Doblhammer & Vaupel, 2001), body size (Phillips & Young, 2000), handedness (Martin & Jones, 1999), and rate of dyslexia (Livingston, Adam, & Bracha, 1993) have all been shown to relate to the season in which an individual is born. There is also evidence for an association of birth season with the rate of some psychiatric conditions including schizophrenia (Torrey, Miller, Rawlings, & Yolken, 1997), affective disorder (Castrogiovanni, Iapichino, Pacchierotti, & Pieraccini, 1998; Clarke et al., 1998), panic disorder (Iapichino, Pieraccini, Di Muro, Del Sole, & Castrogiovanni, 1997), autism (Bolton, Pickles, Harrington, Macdonald, & Rutter, 1992), and depressive or suicidal symptoms (Chotai & Salander Renberg, 2002; Joiner, Pfaff, Acres, & Johnson, 2002).

The majority of research into birth seasonality in psychiatric conditions has focussed on schizophrenia, showing that individuals in the Northern Hemisphere who later develop schizophrenia are more often born in the winter–spring months of January to April, and in the Southern Hemisphere from July to September (Torrey et al., 1997). A number of factors have been suggested to be involved in the season of birth association, including seasonal variations in photoperiod and internal chemistry, external toxins, nutrition, temperature and weather effects, and maternal infection (Tochigi, Okazaki, Kato, & Sasaki, 2004; Torrey et al., 1997). Researchers have also speculated on the time period during which seasonally varying factors may have an influence on development of schizophrenia, be it at conception, gestation, or during the early part of postnatal life (Tochigi et al., 2004).

The season of birth effect on rates of psychiatric disorders in abnormal populations has led researchers to investigate whether season of birth is also associated with personality and behaviour in non-clinical populations. Recent findings have demonstrated an association between season of birth and scores on the temperament scale of novelty seeking (Chotai, Forsgren, Nilsson, & Adolfsson, 2001; Chotai, Johansson, Hagglof, & Adolfsson, 2002; Chotai et al., 2003). Novelty seeking is defined as a tendency towards exploratory activity and intense excitement in response to novelty, impulsive decision making, and active avoidance of monotony or frustration (Cloninger, 1987). Level of novelty seeking was found to be significantly lower among adults aged 35–85 years born during the period containing winter in comparison to those born during the rest of the year, particularly among women (Chotai et al., 2001). An opposite season of birth association for novelty seeking was found among adolescents (Chotai et al., 2002) and young adults (Chotai et al., 2003), with novelty seeking significantly higher among those born during the period containing winter compared to those born during the rest of the year. These findings suggest that the dynamics of personality development differ among adolescents and young adults compared to older adults (Chotai et al., 2002; Chotai et al., 2003; Luby, Svrakic, McCallum, Przybeck, & Cloninger, 1999).

The mechanism underlying the relationship between birth season and level of novelty seeking is so far unknown, but season of birth variations in monoamine neurotransmitter levels, especially dopamine, is one possible causal factor (Chotai et al., 2003). Specifically, previous research has suggested a difference in the turnover of the dopamine–melatonin systems in people born in the half years containing winter (October to March) compared to those born in summer (April to September), perhaps due to the length of photoperiod during gestation or early neonatal development (Chotai & Adolfsson, 2002; Natale, Adan, & Chotai, 2002).

The level of platelet monoamine oxidase (MAO) is associated with brain monoamine neurotransmitter activity, and has long been identified as a biological marker of personality traits (Oreland & Shaskan, 1983). Low levels of MAO are associated with higher levels of the related personality dimensions of novelty seeking, sensation seeking, impulsiveness and monotony avoidance (af Klinteberg, Schalling, Edman, Oreland, & Asberg, 1987; Longato-Stadler, af Klinteberg, Garpenstrand, Oreland, & Hallman, 2002; Oreland, 1993; Oreland & Hallman, 1995; Zuckerman, 1994). The association of novelty seeking and sensation seeking is well documented (McCourt, Gurrera, & Cutter, 1993; Zuckerman & Cloninger, 1996), the latter defined as the seeking of varied, novel, and intense sensations and experiences and the willingness to take physical, social, legal and financial risks for the sake of such experiences (Zuckerman, 1994). Due to this association, sensation seeking may show a similar relationship with season of birth. The current study is an investigation of the association between season of birth and level of sensation seeking in an adult population.

2. Method

2.1. Participants

The participants were 448 students (125 males, 323 females, age range = 20–69, mean age = 39.18, SD = 9.83) from the Open University, UK. The Open University is an adult distance education institution. The majority (87.9%) of participants were from the UK, followed by the rest of Europe (10.9%), and the remainder were from North America. A small number of individuals ($n = 13$) who were born in the Southern Hemisphere were excluded from the analysis due to a possible season of birth effect being shifted by half a year. From the participants, 284 (87 males, 197 females, age range = 20–69 years, mean age = 39.82, SD = 9.48) completed an online version of the questionnaires advertised on a student computer conferencing system and 164 (38 males, 126 females, age range = 20–64 years, mean age = 37.94, SD = 10.23) were given a paper version of the questionnaires at residential school.

2.2. Questionnaires

Level of sensation seeking was assessed using the 40-item Sensation Seeking Scale form V (SSS-V, Zuckerman, 1994; Zuckerman, Eysenck, & Eysenck, 1978) from which is derived a total score and four subscale scores: Thrill and Adventure Seeking (TAS), Experience Seeking (ES), Disinhibition (Dis), and Boredom Susceptibility (BS). Demographic details including gender, age, month of birth, and country of origin were also obtained.

2.3. Analyses

The SSS-V total and subscale scores were first analysed with respect to gender, then scores were correlated with age. Mean levels of SSS-V total were plotted according to age separately by season of birth in order to see how levels of sensation seeking vary with age for each birth season. Season of birth was split into two levels containing individuals born in the half year containing winter (October to March), and individuals born in the half year containing summer (April to September) as in previous studies of personality and season of birth (Chotai et al., 2002; Chotai et al., 2003; Natale et al., 2002).

Next, season of birth variations in levels of sensation seeking were investigated using a four-way multivariate analysis of variance (MANOVA) procedure. Independent variables were gender, age, season of birth, and medium (web or paper version of the questionnaires). The variable 'medium' was included in the analysis to check for possible differences in results obtained by the two methods of questionnaire delivery. Effect sizes were calculated using Cohen's *d* (Cohen, 1988). SPSS Version 11.5 for Windows was used for all statistical analyses.

3. Results

Table 1 shows the distribution of participants according to gender and age. The majority (20.1%) of participants were aged 36–40 years (20.4% of females and 19.2% of males).

3.1. Analysis of SSS-V total and subscale scores by gender and age

Table 2 shows the mean scale scores on the SSS-V for the total sample and for males and females separately. Males scored significantly ($p < 0.0001$) higher on the SSS-V total scale and all subscales except ES.

Fig. 1 shows the mean SSS-V total scores for males and females in the different age groups. SSS-V total score correlated significantly with age among females ($r = -0.19$, $p < 0.0001$), but not males, indicating a decrease in level of sensation seeking with increasing age in females. The subscale scores that significantly correlated with age were TAS (females: $r = -0.21$, $p < 0.0001$; males: $r = -0.22$, $p = 0.016$), and Dis ($r = -0.23$, $p < 0.0001$, females only).

3.2. Season of birth variation in SSS-V total in different age groups

Fig. 2 shows mean levels of SSS-V total plotted according to age separately for those born during the half year containing summer [April to September ($n = 211$); number of participants by age

Table 1
Distribution of participants according to gender and age

Age (years)	All no. (%)	Females no. (%)	Males no. (%)
20–25	36 (8.0)	33 (10.2)	3 (2.4)
26–30	57 (12.7)	41 (12.7)	16 (12.8)
31–35	72 (16.1)	53 (16.4)	19 (15.2)
36–40	90 (20.1)	66 (20.4)	24 (19.2)
41–45	74 (16.5)	53 (16.4)	21 (16.8)
46–50	51 (11.4)	31 (9.6)	20 (16.0)
51–69	68 (15.2)	41 (14.2)	22 (17.6)
Total	448 (100)	323 (100)	125 (100)

Table 2
Mean total and subscale scores on the Sensation Seeking Scale V (SSS-V) for the total sample and separately by gender

	Mean (SD)			t	d
	Total ($N = 448$)	Males ($N = 125$)	Females ($N = 323$)		
SSS-V total	18.27 (6.46)	21.02 (6.19)	17.20 (6.26)	5.81[a]	0.61
TAS	4.99 (2.78)	5.92 (2.81)	4.63 (2.70)	4.48[a]	0.36
ES	6.04 (2.04)	6.27 (2.04)	5.95 (2.04)	1.47	
Dis	4.32 (2.44)	5.19 (2.24)	3.99 (2.42)	4.79[a]	0.51
BS	2.91 (2.00)	3.64 (2.14)	2.62 (1.86)	4.93[a]	0.51

[a] Significant at $p < 0.0001$ (two-tailed t-test); TAS—thrill and adventure seeking; ES—experience seeking; Dis—disinhibition; BS—boredom susceptibility.

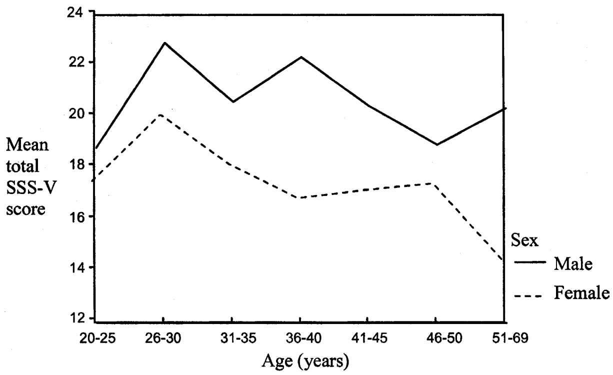

Fig. 1. Mean total scores on the Sensation Seeking Scale V (SSS-V) according to age in males ($n = 125$) and females ($n = 323$).

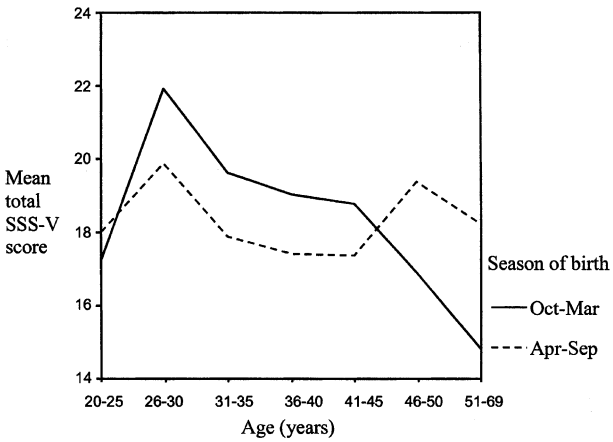

Fig. 2. Mean total scores on the Sensation Seeking Scale V (SSS-V) according to age separately for those born during the half year containing summer (April to September, $n = 211$) and the half year containing winter (October to March, $n = 237$).

category—20–25 years ($n = 14$); 26–30 years ($n = 29$); 31–35 years ($n = 34$); 36–40 years ($n = 43$); 41–45 years ($n = 37$); 46–50 years ($n = 23$); 51–69 years ($n = 31$)], and for those born during the half year containing winter [October to March ($n = 237$); number of participants by age category—20–25 years ($n = 22$); 26–30 years ($n = 28$); 31–35 years ($n = 38$); 36–40 years ($n = 47$); 41–45 years ($n = 37$); 46–50 years ($n = 28$); 51–69 years ($n = 37$)].

Between the first two age groups (20–25 years and 26–30 years) there is an increase in mean SSS-V total score from 17.23 (SD = 4.94) to 21.93 (SD = 5.56) for individuals born during the half year containing winter. Among individuals born during the half year containing summer, there is a smaller increase from 18.0 (SD = 4.99) to 19.86 (SD = 4.9). Thereafter, mean SSS-V total score remains elevated (approximately two points higher) in the former group compared to the latter until around the age of 41–45 years. At this point there is a decline in mean SSS-V total score among individuals born in the half year containing winter while those born in the half year containing summer show a slight increase in mean score.

3.3. MANOVA of gender, age, season of birth and medium on SSS-V total and subscale scores

The graph in Fig. 2 suggests that individuals up to the age of around 41–45 years who were born in the half year containing winter have higher levels of sensation seeking than individuals of the same age who were born in the half year containing summer. Among individuals over 45 years, the relationship appears inverted, with the former group having a lower level of sensation seeking than the latter. A four-way (gender, age, season of birth, and medium) MANOVA was used to examine the possible interaction between season of birth and age on level of sensation seeking, controlling for gender and medium (web or paper questionnaires). Through inspection of the graph in Fig. 2, age was split into two categories in the MANOVA with individuals aged 20–45 years and individuals aged 46–69 years. This age split corresponds to the approximate age where the relationship between season of birth and level of sensation seeking appears to become inverted. Results for SSS-V total are reported first, followed by subscale results.

A significant main effect of gender on SSS-V total was found [$F(1,447) = 30.66$, $p < 0.0001$, $d = 0.61$, means: males = 21.02 (SD = 6.19, $N = 125$) and females = 17.20 (SD = 6.26, $N = 323$)]. The main effect of age on SSS-V total was significant [$F(1,447) = 4.49$, $p = 0.036$, $d = 0.25$, means: 20–45 years = 18.70 (SD = 6.26, $N = 329$) and 46–69 years = 17.07 (SD = 6.87, $N = 119$)]. The variable 'medium' also had a significant main effect [$F(1,447) = 14.88$, $p < 0.0001$, $d = 0.32$, means: paper questionnaire = 19.58 (SD = 6.26, $N = 163$) and web questionnaire = 17.52 (SD = 6.46, $N = 285$)].

Season of birth did not have a significant main effect on SSS-V total, but there was a significant interaction effect of age and season of birth [$F(1,447) = 5.38$, $p = 0.021$, Fig. 3]. On interpretation, the interaction effect suggests that level of sensation seeking is higher in individuals in the younger age group born during the half year containing winter than in individuals of the same age born in the half year containing summer, while the opposite association was found for the older age group i.e. individuals born during the half year containing winter have a lower level of sensation seeking than individuals of the same age born in the half year containing summer. A contrast analysis was conducted to examine the significant interaction between age and season of birth on level of sensation seeking (Rosenthal & Rosnow, 1985). Individuals in both age groups (20–45 and 46–69 years) born in the half year containing summer were weighted as 0, and among those born in

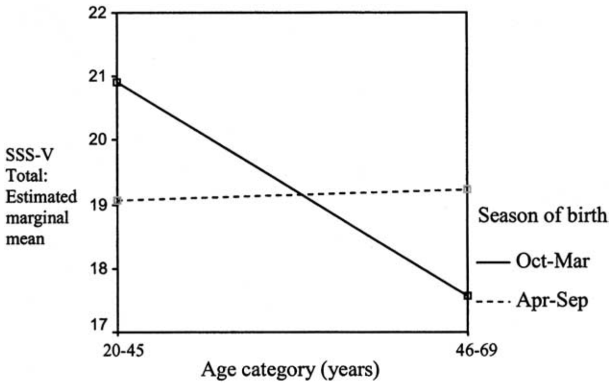

Fig. 3. Interaction of season of birth and age on total sensation seeking score in the total sample ($n = 448$).

the half year containing winter, individuals aged 20–45 years were weighted at 1, and individuals aged 46–69 years were weighted at -1. This contrast was significant [$t(444) = 3.92$, $p < 0.0001$]. None of the interactions containing the variable 'medium' was significant indicating that the relationships found for SSS-V total were present in both datasets (web and paper).

Subscale results revealed a significant main effect of gender on TAS [$F(1,447) = 20.35$, $p < 0.0001$, $d = 0.47$, means: males = 5.92 (SD = 2.81, $N = 125$) and females = 4.63 (SD = 2.70, $N = 323$)], Dis [$F(1,447) = 18.40$, $p < 0.0001$, $d = 0.51$, means: males = 5.19 (SD = 2.25, $N = 125$) and females = 3.99 (SD = 2.43, $N = 323$)], and BS [$F(1,447) = 17.06$, $p < 0.0001$, $d = 0.51$, means: males = 3.64 (SD = 2.14, $N = 125$) and females = 2.62 (SD = 1.87, $N = 323$)], but not on the ES subscale. Age had a significant main effect on the TAS subscale only [$F(1,447) = 7.07$, $p = 0.008$, $d = 0.28$, means: 20–45 years = 5.19 (SD = 2.77, $N = 329$) and 46–69 years = 4.42 (SD = 2.77, $N = 119$)]. Medium had a significant main effect on TAS [$F(1,447) = 7.29$, $p = 0.007$, $d = 0.23$, means: paper questionnaire = 5.39 (SD = 2.63, $N = 163$) and web questionnaire = 4.76 (SD = 2.86, $N = 285$)], ES [$F(1,447) = 8.51$, $p = 0.004$, $d = 0.22$, means: paper questionnaire = 6.33 (SD = 1.96, $N = 163$) and web questionnaire = 5.88 (SD = 2.07, $N = 285$)], and Dis [$F(1,447) = 9.28$, $p = 0.002$, $d = 0.32$, means: paper questionnaire = 4.82 (SD = 2.38, $N = 163$) and web questionnaire = 4.04 (SD = 2.43, $N = 285$)], but not on the BS subscale.

There was no significant main effect of season of birth on subscale scores, but there was a significant interaction between age and season of birth on TAS scores [$F(1,447) = 6.30$, $p = 0.012$]. A higher level of TAS was found in individuals in the younger age group who were born in the half year containing winter compared to individuals of the same age born in the half year containing summer, while the opposite association was found in the older age group. A contrast analysis conducted to examine the significant interaction between age and season of birth on level of TAS (using the same weightings as previously for sensation seeking total) was significant [$t(444) = 4.26$, $p < 0.0001$]. However, a three-way interaction between age, season of birth and medium for TAS [$F(1,447) = 4.08$, $p = 0.044$] showed that the interaction between age and season of birth was significant only in the data from the web version of the questionnaire. A separate analysis with the data derived from the paper version of the questionnaire revealed that there was a trend for the same pattern of results in this dataset, but it did not reach statistical significance.

In summary, results indicate an association between level of sensation seeking and season of birth in interaction with age. Level of sensation seeking is higher in individuals aged 20–45 years born during the half year containing winter than in individuals of the same age born in the half year containing summer, while the opposite association was found for individuals aged over 45 years.

4. Discussion

Results from the present study show an opposite relationship between level of sensation seeking and season of birth in individuals aged 20–45 years (higher level of sensation seeking in those born during the half year containing winter) compared to those aged 46–69 years (higher level of sensation seeking among those born during the half year containing summer). The fact that Chotai et al. (2001, 2002, 2003) found a similar relationship between novelty seeking and season of birth supports the link between novelty seeking and sensation seeking and provides evidence that they are investigating the same underlying trait.

The results also suggest that the neurophysiological underpinnings of novelty/sensation seeking are subject to seasonally varying environmental influences, although understanding of possible mechanisms underlying this effect is at present equivocal. It has been suggested that the season of birth difference may be associated with differences in the rate of turnover of dopamine in individuals born during different seasons (Chotai et al., 2002), as dopamine is likely to be related to the underlying neurophysiological system governing both novelty seeking and sensation seeking (Depue & Collins, 1999). Season of birth may modulate the early development of the monoaminergic systems, and the turnover of monoamines such as dopamine may be affected by whether individuals are born during the long or the short photoperiod part of the year (Chotai et al., 2002; Chotai et al., 2003). Two pieces of evidence support the hypothesis that the season of birth association for dopamine turnover in adults may be related to the length of the photoperiod during gestation or neonatal life. Firstly, dopamine is functionally related to melatonin since they are mutually inhibitory signals for day and night (Grosse & Davis, 1999; Tosini & Dirden, 2000), and secondly a difference in 'morningness–eveningness' preference has been found in those born during the long compared to the short photoperiod of the year (Natale & Adan, 1999; Natale et al., 2002). However, season of birth associations may also be related to other seasonally varying factors, for example, neonatal infections have been found to influence the postnatal development of brain monoaminergic systems (Herlenius & Lagercrantz, 2001; Pletnikov, Rubin, Schwartz, Carbone, & Moran, 2000).

The differential association of both sensation seeking and novelty seeking with season of birth across different age groups may also be related to neurotransmitter levels. Chotai et al. (2003) suggest that there may be a developmental difference between people born during different seasons regarding the dynamics of the turnover and interaction among the monoamine neurotransmitters in parallel to the development of personality traits across the lifespan. On inspection of Fig. 2, it shows that individuals born during the half year containing winter show a higher rise in level of sensation seeking during early adulthood and a steeper fall in sensation seeking during later years when compared to individuals born during the rest of the year. This is similar to the collective findings of Chotai et al. (2001), Chotai et al. (2002) and Chotai et al. (2003) for novelty seeking. The steeper increase in level of sensation seeking in the former group compared to the latter may be associated with a steeper increase in monoaminergic activity. The level of platelet MAO (an indicator of brain monoaminergic activity) remains stable over several decades, however, with a possible increase after the age of around 40 years (Bagdy & Rihmer, 1986; Bridge et al., 1985; Murphy et al., 1976; Robinson et al., 1972), which is likely to be associated with a decrease in dopamine levels. The association between increasing age and a decreased level of dopaminergic activity has been well documented (Arranz et al., 1996; Burchinsky, 1985; Zuckerman, 1994). It is possible that the level of dopaminergic activity is subject to a greater decline in later years among individuals born during the half year containing winter compared to individuals born during the rest of the year, which may be associated with the steeper decline in level of sensation seeking in the mid 40s in the former group.

The finding of an association of gender with sensation seeking in the present study replicates reliable associations found repeatedly in previous studies (see Zuckerman, 1994, for a review). In the present study, males scored significantly higher than females on the SSS-V total scale and all subscales except ES. The lack of a gender difference on the ES subscale agrees with previous findings and suggests that women are equally open to new experiences, while men are higher on the active forms of sensation seeking (Zuckerman, 1994).

In addition to the interaction effect of age and season of birth on level of sensation seeking, age had a significant main effect on level of sensation seeking, with the younger age group having higher scores. The plot of mean level of sensation seeking according to gender and age (Fig. 1) suggests an increase in sensation seeking in the early 20s, showing a peak among individuals aged 26–30 years and a significant decline thereafter among females, but not males. Level of sensation seeking is believed to increase in childhood to a peak in adolescence or young adulthood (early 20s), and then to decline with age thereafter in both males and females (Zuckerman, 1994). The fact that a significant decline in level of sensation seeking with age was not found for males in this study may have been due to the smaller number of males compared to females obscuring the relationship between age and sensation seeking. Also, the age at which level of sensation seeking reaches its peak is shifted up in this study (age 26–30 years) compared to previous studies. This is perhaps due to the increasing number of individuals not leaving the parental home until around this age, or possibly to the increasing age at marriage, leading to increased opportunities for exploration and risk taking around this age. A similar age-related pattern was found for the subscales TAS (males and females) and Dis (females only), while ES and BS showed an increase in early adulthood, but no steady decline in later years, in agreement with Zuckerman (1994), who reported that TAS and Dis tend to show steadier and stronger age changes than the other subscales.

There was also a significant effect of medium on sensation seeking scores with a higher (by approximately two points) mean level of sensation seeking found in the group who completed the paper version of the questionnaire compared to the online version. The results suggest an increased level of self-disclosure, perhaps leading to reporting of higher levels of sensation seeking by the individuals completing the paper version. However, the converse has been found in previous research, with increased self-disclosure among individuals completing a web questionnaire compared to a paper version, with perceived anonymity thought to play a major role (Joinson, 1999). Perhaps self-selection played a role in this finding, as residential schools are not compulsory in the Open University and it is likely that the more sociable students chose to attend. Although the method of questionnaire delivery did have an effect on level of sensation seeking, it is notable that it did not influence the relationship of the main variables under investigation, suggesting that the same psychological factors drove results in the data derived from the web and paper versions of the questionnaire (Buchanan, 2001; Krantz, Ballard, & Scher, 1997).

This study is cross-sectional in nature with all the attendant weaknesses associated with such a design. In particular, due to the fact that it is only possible to compare mean sensation seeking scores between different age groups, there is a possibility that the age-related changes in sensation seeking levels found in this study may be a reflection of generational differences rather than age-related changes in the level of sensation seeking. A further analysis of sensation seeking across the lifespan would require a longitudinal study.

Another weakness of this study is the fact that the majority of the sample is female (72%). The skewed gender distribution is likely to reflect the fact that the majority of respondents was from social science courses, and these courses have more female students. As participation in the study was entirely voluntary, response rate may also have been influenced by gender differences in self-disclosure, as many of the questions were personal in nature and women tend to be more willing to disclose personal information (see Dindia & Allen, 1992, for a meta-analysis).

The number of individuals who originated from the Southern Hemisphere ($n = 13$) was too small to perform a separate analysis in order to see whether the season of birth effect was shifted by half a year among these individuals, but this is an important area for future study. It would also be of interest to investigate whether the season of birth effect increases at higher latitudes, and if the effect is absent among individuals from equatorial countries.

If season of birth can be assumed to be acting as a marker for a seasonally fluctuating non-genetic factor, future studies should focus on identifying the factors that cause the season of birth associations. Animal experiments in which variables such as length of photoperiod, infection, and ambient temperature could be controlled would be useful to explore how these factors influence brain development (Tochigi et al., 2004). Research is also required to identify the susceptible period (or periods) in embryonic or neonatal life, and the molecular, pharmacological, and physiological mechanisms underlying the factors causing the season of birth effect.

Acknowledgement

This research was supported by a grant (no. F/00269/H) from the Leverhulme Trust to The Open University.

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