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Contagious yawning and Big Five personality traits

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For comprehensive investigation of personality factors related to a propensity for contagious yawning, we examined the relation between the Big Five score and individual differences in self-reported contagious yawning. Participants were instructed to imagine an acquaintance's expressionless face and yawning face, and to report the frequency of yawning for each period. Furthermore, they were asked to complete the NEO-Five Factor Inventory (NEO-FFI). The relation between the self-reported contagious yawning frequency and each Big Five score from the NEO-FFI was analyzed. Results revealed a positive association with Agreeableness, Extraversion and Openness, and a negative association with Conscientiousness for self-reported contagious yawning frequency. These results suggest that contagious yawning depends on individual differences of empathy, attention to social stimuli, and physiological impulsivity.

Key words: contagious yawning, Big Five personality traits, individual differences, empathy

Introduction

Earlier studies of yawning, a common phenomenon displayed by vertebrates of most classes (Baenninger, 1987), have demonstrated that yawning frequency is increased by changes of ambient temperature (Gallup & Eldakar, 2011) and that yawning is inhibited by forehead cooling (Gallup & Gallup Jr., 2007). These findings suggest that yawning has a thermoregulatory (cooling) effect on the brain (Gallup & Eldakar, 2013). However, evidence that yawning regulates the brain arousal level remains insufficient (Guggisberg, Mathis, Schnider, & Hess, 2010). Moreover, yawning is not expressed only spontaneously.

It is particularly interesting that yawning can also result from observation of other people's yawning: so-called *contagious yawning*. Earlier studies have demonstrated that contagious yawning can be induced by seeing a yawning face (Provine, 1989), by reading or thinking about a yawn (Provine, 1986), or by hearing a yawning voice (Massen, Church, & Gallup, 2015).

Recently some researchers have examined that contagious yawning is characterized by internal factors such as empathy (e.g., Franzen, Mader, & Winter, 2018; Platek, Critton, Myers, & Gallup Jr., 2003; Rundle, Vaughn, & Stanford, 2015). For example, Franzen et al. (2018) found a relation between contagious yawning and empathy, as measured using the Interpersonal Reactivity Index. In addition, Platek et al. (2003) demonstrated that contagious yawning correlates positively with results of theory of mind tasks and self-face recognition tasks, and negatively correlates with schizophrenia personality traits. Furthermore, Rundle et al. (2015)

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reported that contagious yawning correlates negatively with psychopathic personality traits. Moreover, children with autism spectrum disorder (ASD) show less contagious yawning than typically developed (TD) children do (e.g., Giganti & Esposito ZIELLO, 2009; Senju et al., 2007).

However, the results of earlier studies examining contagious yawning and empathy are inconsistent with these findings. Massen and Gallup (2017) reviewed several studies that used some questionnaires and cognitive measures of empathy to explore links between contagious yawning and empathy. They reported that only 6 of 22 studies (27.3%) demonstrated significant relations. Bartholomew and Cirulli (2014) found no influence of scores of the Interpersonal Reactivity Index or emotional contagion on the frequency of contagious yawning.

To clarify the internal factors contributing to such individual differences in contagious yawning, one useful method is investigation of the association of more comprehensive personality traits with contagious yawning. Therefore, this study examined the relation between Big Five personality traits and individual differences in contagious yawning. The Big Five model consisting of Neuroticism, Extraversion, Openness, Agreeableness, and Conscientiousness is well known as a comprehensive theory of personality traits (Costa & McCrae, 1992). Of these factors, Agreeableness is an especially important factor related to empathy or sociality. Many studies have demonstrated that Agreeableness is positively linked to empathy as measured by the Interpersonal Reactivity Index (Melchers et al., 2016; Song & Shi, 2017), Empathy Quotient (Melchers et al., 2016) or the Jefferson Scale of Physician Empathy (Costa et al., 2014; Costa, Magalhães, & Costa, 2013; Magalhães, Costa, & Costa, 2012). In addition to Agreeableness, some reports have described that Openness (Costa et al., 2014; Costa et al., 2013; Magalhães et al., 2012; Melchers et al., 2016; Song & Shi, 2017) and Conscientiousness (Melchers et al., 2016; Song & Shi, 2017) have positive associations with empathy. Therefore, if contagious yawning is influenced by empathy, then a high Agreeableness or Openness, Conscientiousness score can be predicted to be positively associated with contagious yawning.

Extraversion is a factor related to attention to social stimuli. For instance, Fishman, Ng, and Bellugi (2011) used event-related potential (ERP) procedures to demonstrate that higher scores on extraversion are associated with enhanced attention to social stimuli such as human faces. Therefore, we predict that, in addition to Agreeableness, Openness and Conscientiousness, the Extraversion score is also positively related to the frequency of contagious yawning.

Methods

Participants

The experiment included 309 undergraduate students (148 male, 161 female; mean age 20.0 years, $SD=0.92$). All gave informed consent to participation in this study.

Measures

The Big Five personality factors were assessed using the Japanese version (Shimonaka, Nakazato, Gondo, & Takayama, 1999) of the NEO-Five Factor Inventory (NEO-FFI; Costa & McCrae, 1992): a self-administered questionnaire consisting of 60 items (12 for each of 5 personality factors) rated on a five-point Likert scale with responses from "strongly disagree (1)" to "strongly agree (5)". This Japanese version has acceptable internal consistency and reliability (Shimonaka et al., 1999).

Procedures

Experiments were conducted for groups divided into 14 times (each about 20 participants) during a lecture time in the afternoon. The temperature, humidity, and oxygen concentration in the classroom were not specifically controlled.

Experiments consisted of three steps. As the first step, participants self-reported their sex, age, hours they slept the prior night, and hours elapsed since they woke up. The sleeping time and elapsed time from waking were recorded to elucidate an association of physiological factors with contagious yawning (Giganti & Zilli, 2011). In the second step, participants performed the experimental task of contagious yawning described below. In the final step, they were asked to fill out the NEO-FFI.

For this study, we measured self-reported yawning. The experiment task of contagious yawning consisted of the following. A participant was asked to imagine an expressionless face of an acquaintance for 3 min with closed eyes, and to record the yawning frequency during this period (control condition). Next, they were asked to imagine the same person's yawning face for 3 min with closed eyes, and to record the frequency of yawning (yawning condition). To suppress the influence of recording yawning frequency under the previous condition on the yawning occurrence under the following condition, the order of control and yawning conditions was counterbalanced across groups of participants. At the end of the task, they reported whether they were able to imagine an acquaintance's face or not, and reported the identity of the acquaintance: father, mother, brother or sister, same-sex friend, opposite-sex friend, or other. To control participants' image ability, the data of participants unable to imagine a face were excluded from analyses.

If using a procedure such as actually perceiving yawning faces (as video or photograph stimuli) in a group experiment, then yawning by other nearby participants might induce yawning contagiously as the participants open their eyes, even in a control condition. Therefore, we used a procedure of imagining a yawning face with closed eyes. Moreover, to prevent effects of yawning by other nearby participants, for the experiment task, participants were instructed to yawn with inclusion of the least voice possible. In addition, participants were required to sit apart from one another in the classroom.

Ethics

The Research Ethics Committee of Iwaki Meisei University approved this study.

Results

Of 309 participants, 24 (16 male, 8 female) participants were unable to imagine an acquaintance's face, 16 (7 male, 9 female) participants selected "other" as an acquaintance they thought about, such as an animated character. These 40 participants' data were excluded from analyses. Furthermore, seven participants reported a yawning frequency in the yawning or control condition higher than mean + 3 SD. Also, nine participants reported a sleeping time and elapsed time from waking higher than mean + 3 SD or lower than mean - 3 SD. These 16 participants' data were excluded from analyses as outliers. Therefore, 253 participants' data (119 male, 134 female; mean age was 20.0 years, $SD = 0.92$) were used for analyses. Table 1 presents summary results for the respective variables.

Table 1. Results for respective variables

Variable	Mean	Min	Max	SD
Yawning frequency in yawning condition	1.18	0	6	1.46
Yawning frequency in control condition	0.42	0	3	0.79
Sleeping time (min)	375.19	120	720	103.42
Elapsed time from waking (min)	355.93	30	790	130.65
Neuroticism	31.93	12	48	7.95
Extraversion	23.64	5	43	7.54
Openness	30.31	17	43	5.20
Agreeableness	27.86	6	40	5.88
Conscientiousness	24.26	3	46	7.25

The mean yawning frequency was 1.20 ($SD = 1.48$) in the yawning condition and 0.46 ($SD = 0.88$) in the control condition. To compare frequencies among conditions, we applied Wilcoxon signed-rank tests. Results reveal that the participants yawned significantly more frequently in the yawning condition than in the control condition ($S(252) = 3731.5$, $p < .0001$, $r = 0.51$).

To investigate the influences of the respective variables on the frequency in the yawning condition, i.e., contagious yawning frequency, we used a generalized linear model (GLM) based on a Poisson distribution (logarithmic link function). The response variable was the contagious yawning frequency. Explanatory variables were the NEO-FFI score, sleeping time, and elapsed time from waking as continuous variables, and, as a nominal variable, an acquaintance whom they thought about. To identify the best subset of respective variables, all possible models were compared based on Akaike's information criterion corrected (AICc). In contrast with the full model (AICc = 464.4), the AIC-based optimal model included only the scores of Extraversion and Conscientiousness (Likelihood ratio $\chi^2(2) = 9.88$, $p < .008$, AICc = 454.43), as

shown in Table 2. Of these variables, although the Extraversion score ($B = 0.03$, $Wald \chi^2(1) = 5.39$, $p < .05$) was found to have a significant positive association, the Conscientiousness score ($B = -0.03$, $Wald \chi^2(1) = 7.99$, $p < .005$) was found to have a significant negative association. No significant relation was found for any score of Openness, Neuroticism, Agreeableness, sleeping time, elapsed time from waking, or an acquaintance they thought about.

Table 2. Results of optimal Generalized Linear Model on frequency of contagious yawning

Variable	B	SE	95% Confidence Interval		Wald χ^2	P
			Lower	Upper		
Intercept	0.33	0.31	-0.30	0.92	1.04	0.31
Extraversion	0.03	0.01	0.00	0.05	5.39	.03
Conscientiousness	-0.03	0.01	-0.06	-0.01	5.39	.005

To compare Big Five scores of participants who yawned at least once in a yawning condition ($N = 137$) to those of participants who did not yawn ($N = 116$), two-sided t -tests were applied. Table 3 presents means for each NEO-FFI score of the respective participant groups. Significant differences of scores were found among participant groups for Extraversion, Openness, Agreeableness, and Conscientiousness: participants who yawned contagiously showed marginally and significantly higher scores of Openness ($t(251) = 2.13$, $p < .05$, $r = 0.13$) and Agreeableness ($t(251) = 2.05$, $p < .03$, $r = 0.13$), and lower scores of Conscientiousness ($t(251) = -2.18$, $p < .04$, $r = 0.14$) than participants who did not yawn contagiously.

Table 3. Means (standard deviations) for each NEO-FFI score of Non-yawners and Yawners.

Variable	Non-yawners ($N=116$)	Yawners ($N=137$)	P
	Mean (SD)	Mean (SD)	
Neuroticism	31.66 (7.27)	32.15 (8.51)	.63
Extraversion	22.74 (7.25)	24.40 (7.72)	.08
Openness	29.56 (5.55)	30.95 (4.82)	.03
Agreeableness	27.04 (5.68)	28.55 (5.97)	.04
Conscientiousness	25.33 (7.49)	23.35 (6.94)	.03

Discussion

This study investigated the personality factors influencing the individual differences of contagious yawning. The self-reported yawning frequencies when imagining an expressionless face (control condition) and a yawning face (yawning condition) were measured. We analyzed relations between the frequency of contagious yawning and the respective factors of NEO-

FFI, sleeping time, elapsed time from waking, and an acquaintance whom the participants imagined.

Results in GLM for the frequency of contagious yawning showed that Extraversion had a significant and positive association and showed that Conscientiousness had a significant and negative association. Furthermore, participants who yawned in a yawning condition showed marginally and significantly higher scores of Extraversion, Openness and Agreeableness, and lower scores of Conscientiousness than participants who did not.

Participants who yawned contagiously showed a higher score of Agreeableness than participants who did not. Many reports of earlier studies have described that Agreeableness is associated with empathy (Costa et al., 2014; Costa et al., 2013; Graziano, Habashi, Sheese, & Tobin, 2007; Magalhães et al., 2012; Melchers et al., 2016; Song & Shi, 2017). Agreeableness and empathy share properties related to prosocial or altruistic interpersonal behavior (Ashton & Lee, 2001; Caprara, Alessandri, Di Giunta, Panerai, & Eisenberg, 2010; Hojat et al., 2005). Furthermore, Agreeableness and empathy overlap neurophysiological mechanisms that can interpret actions, mental states or feeling states of other people as mirror neuron systems (Cheng et al., 2009; DeYoung et al., 2010). Therefore, a positive relation between contagious yawning and Agreeableness in this study is presumed as reflecting empathy, similarly to previous studies (Franzen et al., 2018; Platek et al., 2003; Rundle et al., 2015).

Moreover, participants who yawned contagiously had a higher score of Openness than participants who did not. High scores of Openness relate to the sensitivity to understand the others' internal states as thoughts, feelings, or intentions that are linked to empathy (Costa et al., 2013; DeYoung, Peterson, & Higgins, 2005). Therefore, this result also suggests a positive association of contagious yawning with empathy.

In this study, in addition to Agreeableness and Openness, Extraversion was shown to have a significant and positive association. Although Nettle (2007) reported that Agreeableness and Extraversion were found to be significantly associated with higher Empathy Quotient values, few reports describe the relation between Extraversion and empathy. Instead, Extraversion is a factor related to attention to social stimuli (Fishman et al., 2011). Therefore, contagious yawning may depend on individual differences of attention to the face of another person. This possibility of dependence is supported by results reported by Senju et al. (2009), which demonstrated that children with ASD and TD children expressed contagious yawning equally when instructed to fixate their gaze on the eye area of a yawning face. Senju et al. (2009) inferred that individual differences of contagious yawning are likely to be related to individual differences of social orienting. Consequently, results obtained from the present study suggest that contagious yawning is linked to the attention to social stimuli, which is related to Extraversion.

Conscientiousness was found to have a significant and negative association. However, prior reports have described that Conscientiousness is positively associated with empathy (Melchers et al., 2016; Song & Shi, 2017). To explain such a contradiction, one must remember that yawning is an impulsive physiological response. Conscientiousness is related to inhibition

capability of impulsivity or self-control (DeYoung et al., 2010). Negative association in this study presumably indicates that lower Conscientiousness scores, such as less-inhibited physiological impulse, are associated with more frequent yawning.

However, it is noteworthy that we measured self-reported yawning. Although such a procedure has been used by Bartholomew and Cirulli (2014), they might have affected participant responses (Franzen et al., 2018) because the experiment instructions made participants aware of yawning: listening to the word “yawning” might stimulate yawning in both yawning and control conditions. In addition, some participants might have realized the experiment purpose. For those reasons, yawning might have been promoted in participants who have some personality trait. Future studies must examine the relation between contagious yawning and Big Five scores must be examined using other experiment procedures, such as a procedure with presentation of actual video stimuli of a yawning face.

We have described a positive association with Agreeableness, Extraversion, and Openness, and a negative association with Conscientiousness for self-reported contagious yawning: individual differences of empathy, attention to others, and physiological impulsivity are apparently associated with a propensity for yawning contagiously. No association of Big Five scores with individual differences of a propensity for contagious yawning has been reported from any earlier study. Therefore, this study has provided useful findings suggesting correlation between personality traits and contagious yawning.

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