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The influence of personality on social attention

David W.-L. Wu [a,*], Walter F. Bischof [b], Nicola C. Anderson [c], Tanya Jakobsen [a], Alan Kingstone [a,*]

[a] Department of Psychology, University of British Columbia, Canada
[b] Department of Computing Science, University of Alberta, Canada
[c] Department of Cognitive Psychology, Vrije Universiteit, Amsterdam, The Netherlands

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ABSTRACT

The intersection between personality psychology and the study of social attention has been relatively untouched. We present an initial study that investigates the influence of the Big Five personality traits on eye movement behaviour towards social stimuli. By combining a free-viewing eye-tracking paradigm with canonical correlation and regression analyses, we discover that personality relates to fixations towards eye regions. Specifically, Extraversion and Agreeableness were related to greater gaze selection, while Openness to Experience was related to diminished gaze selection. The results demonstrate that *who* a person is affects *how* they move their eyes to social stimuli. The results also indicate that personality is a stronger factor in predicting social attention than past studies have suggested. Critical to the influence of personality on attention is the social situations viewers are placed in.

1. Introduction

Current theory suggests that people have an automatic tendency to attend to the eyes of social agents because they provide foundational information for understanding the intentions and internal states of others (see for a review, Shepherd, 2010). Stemming from this theory, researchers have explored the idea that individual differences in the capacity for social understanding may determine how people attend to social stimuli. For example, Bayliss, Pellegrino, and Tipper (2005) found that participants who scored higher on the Autism Quotient (AQ; Baron-Cohen, Wheelwright, Skinner, Martin, & Clubley, 2001) had reduced cuing effects in a gaze-cuing paradigm.

This question about the relationship between the AQ and social attention has recently been extended beyond the gaze-cuing paradigm to how people select and attend to natural social stimuli. A recent study by Freeth, Foulsham, and Kingstone (2013) found that participants who had a higher AQ looked less at other people when they were depicted in a video, but in a live situation there was no relationship between the AQ scores and social attention. However, these results contradict previous findings that a higher AQ is correlated with reduced attention to individuals embedded in a real world situation, but not when people are depicted in video (Laidlaw, Foulsham, Kuhn, & Kingstone, 2011). While in general these studies support the theory that looking at the eyes of others is based on the need for social understanding, the conflicting findings involving the AQ suggest that it is not a particularly reliable indicator of the relationship between social attention and looking behaviour.

We think it would be premature to conclude from these particular AQ findings, however, that personality overall is not a strong determinant of social attention. Yet, researchers asking the question "where do people look" have rarely explored differences in *who* those people are. To the extent that individual differences have been investigated in the social attention literature, they largely concern gross physiological differences like gender, age, or clinical disorders (see for a review, Frischen, Bayliss, & Tipper, 2007). Other personality traits besides the AQ have not been explored systematically in relation to social attention. Therefore it may be that the AQ is simply one personality trait that is not a strong predictor of social attention, and it is not representative of the importance of other personality traits. Support for this view comes from questionnaire studies suggesting that the AQ is an independent personality dimension, not captured by other personality dimensions (Austin, 2005; Wakabayashi, Baron-Cohen, & Wheelwright, 2006), and from recent empirical investigations indicating that other traits, such as perceptual curiosity, are strongly related to exploratory looking behaviour (Risko, Anderson, Lanthier, & Kingstone, 2012). Therefore, the purpose of this investigation is to expand the literature on personality and social attention to determine whether personality traits other than the AQ can strongly predict social attention. To do this, we examined the influence of the most comprehensive personality model, the Big Five personality traits, on looking behaviour

* Corresponding author. Address: Department of Psychology, University of British Columbia, 2136 West Mall, Vancouver, BC V6T 1Z4, Canada. Tel.: +1 604 822 0069
E-mail addresses: david.wl.wu@gmail.com (D.W.-L. Wu), alan.kingstone@ubc.ca (A. Kingstone).

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towards social stimuli, specifically the eye regions of static social scenes in a free-viewing paradigm.

The Big Five personality traits (also called the Five Factor Model) is the most widely-accepted personality model in psychology (Digman, 1990; Goldberg, 1990; John & Srivastava, 1999; McCrae & John, 1992). The Big Five personality traits are Extraversion, Agreeableness, Conscientiousness, Neuroticism, and Openness to Experience. It has been used in many different fields of study outside of personality psychology, including clinical psychology (Samuel & Widiger, 2008), applied psychology (Zhao & Seibert, 2006), and neuroscience (DeYoung et al., 2010). The Big Five traits have revealed that "who one is" is a strong and pervasive predictor of human behaviour and cognition, from entrepreneurship (Zhao & Seibert, 2006) to artistic preference (Chamorro-Premuzic, Reimers, Hsu, & Ahmetoglu, 2009). Notably absent from the social attention literature is the use of the Big Five. Since the beginning, social attention research has focused on how external factors, like task demands, influence attention (Yarbus, 1967). Given that the Big Five appears to relate to so many aspects of human behaviour, it seems to be an excellent starting point for bringing together the literature on personality and social attention.

While no one has yet explored how the Big Five influences eye movements, there are some predictions that can be made based on prior personality and social attention research. A study by Berry and Hansen (2000) found that Extraversion, Agreeableness, and Openness to Experience were positively related to the quality of social interaction between female strangers in a spontaneous real-world situation where the dyads were left alone to interact for six minutes. Extraversion and Agreeableness were both positively related to the quality of the interaction as rated by the participants and third party observers. Moreover, Agreeableness and Openness were specifically related to the degree of visual contact between participants, and they mediated how third party observers rated the interactions. If the quality of social interaction is related to social understanding, and social understanding underlies attention towards eyes, then the three personality traits of Extraversion, Agreeableness, and Openness to Experience should be related to gaze selection. Agreeableness and Openness may be an especially strong predictor based on Berry and Hansen (2000)'s finding.

2. Methods

2.1. Participants

Fifty students from the University of British Columbia were given course credit or paid $5 to participate in the present study.

2.2. Stimuli

Thirty unique images featuring fractals, landscape, and human scenes were presented (10 of each type; fractals and landscapes were from Foulsham & Kingstone, 2010; human scenes were from Birmingham, Bischof, & Kingstone, 2008). Fractal and landscape scenes were used to investigate another research question unrelated to this study (see Wu, Anderson, Bischof, & Kingstone, in press). Human scenes involved pictures of three-people interacting (e.g., playing a board game), three-people not interacting, and scenes with just one person. In all images the models were seated in interior settings. Because both the number of people in a scene and the level of interaction can influence the amount of attention towards eye regions (Birmingham et al., 2008), a sampling from these scenes provided a reasonable average. The scenes were 1024 × 768 pixels, and corresponded to a horizontal visual angle approximating 42°, and a vertical visual angle approximating 33°.

2.3. Questionnaires

Each participant was asked to complete the 44-item Big Five Inventory (BFI; Benet-Martínez & John, 1998; John & Srivastava, 1999). This inventory is widely used in the literature, and has high internal reliability for each Big Five trait, ranging from $\alpha = .79$ to .88, with a mean $\alpha = .83$ (Benet-Martínez & John, 1998). This is comparable to other shortened Big Five questionnaires, but the BFI is considerably more efficient taking only five minutes to complete, and is also easier to understand (John & Srivastava, 1999).

2.4. Apparatus

An SR Research Eyelink 1000 eye-tracking system, recorded participants' eye movements at 1000 Hz. Stimuli were presented to participants on a 23" monitor. Scenes and eye movements were also presented to the experimenter on an adjacent monitor located in the testing room, relaying real-time feedback on system accuracy.

2.5. Procedure

Participants were seated 60 cm from the computer monitor, with their heads positioned in a chin rest. Participants were told to freely view each image as they would normally. Images were presented for 10 s. Participants viewed 30 randomly ordered images before being asked to complete the questionnaires.

2.6. Data analysis

Interest areas were defined for the eye regions of the human scenes as was done in Birmingham et al. (2008). We quantified both the total amount of time participants spent looking at these eye regions, and the average duration of fixations in these eye regions. Previous results using these humans scenes showed that participants fixate more to the eyes than any other region in the scene (Birmingham et al., 2008). This tendency remained true across different tasks (e.g., free-viewing versus describing the picture), and across the amount of activity in the scene (e.g., whether people in the scene were interacting or not).

3. Results

3.1. Canonical correlation analysis

To investigate the relationship between the variable sets, personality and social attention, a canonical correlational analysis (Sherry & Henson, 2005) was conducted with the Big Five traits as the *predictor variables*, and the average fixation duration towards the eye region and the total time spent in the eye region of human scenes as the *dependent variables*. A canonical correlation creates synthetic predictor and dependent variables (i.e., variables extrapolated from direct measurement) using linear equations from the underlying variable sets (analogous to multiple regression). These two linear equations are created to yield the maximum possible correlation between the two synthetic variables. Canonical correlation analysis is advantageous when there are multiple predictor and dependent variables because it limits the possibility of a Type I error. As a multivariate technique, it does not require separate analyses for each dependent variable

examined, and theoretically aligns well with the reality of psychological research in examining complex human behaviour where there are multiple causes and effects (Sherry & Henson, 2005).

The canonical correlations yielded two functions with squared canonical functions (R_c^2) of .353, and .088 for each successive function. Considered collectively, the full model across both functions was significant, Wilks's $\lambda = .590$, $F(10, 86) = 2.595$, $p = .008$. The effect size of the full model can be determined by calculating $1 - \lambda$ (Sherry & Henson, 2005), meaning in this case that the full model explained 1-.59 or 41% of the shared variance between personality and social attention. A dimension reduction analysis revealed that while the first function explained a significant portion of the variance between personality and social attention, the second function did not, Wilks's $\lambda = .912$, $F(4, 44) = 1.065$, $p = .385$. Thus, only the first function was examined. See Fig. 1 for a visual depiction of the model of the first function.

The squared canonical correlation (R_c^2) value for the first function was .353, meaning the function explained 35.3% of the shared variance between the variable sets, personality and social attention. Table 1 displays the standardized canonical coefficients (i.e., canonical weights), structure coefficients (i.e., factor loadings), and communality coefficients for the function. Looking at these values, we see that Extraversion, Agreeableness, and Openness are the relevant predictor variables. Of particular interest is Openness, which had a communality coefficient (h^2) approximately four times as high as Extraversion or Agreeableness, suggesting it is four times as useful in the model as the next most relevant predictor variable. Importantly, the signs for the coefficients for Openness were the inverse of the signs of all other variables, including the dependent variables, indicating a negative relationship. Therefore, participants who had higher Openness scores spent less time fixating at eye regions, whereas participants who had higher scores on Extraversion or Agreeableness, spent more time at eye regions.

As for the dependent variables, both average fixation duration and total fixation time looking at eyes were relevant for the measurement of social attention, with both variables having high structure and communality coefficients. Interestingly, both variables had structure coefficients greater than their standardized canonical coefficients, which is the opposite of that on the predictor side. A relatively high structure coefficient with a low canonical coefficient implies a high degree of multicollinearity (Sherry & Henson, 2005). Therefore, average fixation duration and total fixation time are highly related (e.g., people look long and frequently at the eyes), whereas the Big Five traits (except for conscientiousness) uniquely contributed to the personality variate synthesized by the canonical function.

3.2. Multiple regression analysis

After establishing that Big Five influences social attention with the canonical correlation analysis, multiple regressions can further investigate how personality impacts each dependent variable separately. Big Five traits explained a significant amount of variance of both average fixation duration, $R^2 = .26$, $F(5, 44) = 3.02$, $p = .02$, and total fixation time, $R^2 = .31$, $F(5, 44) = 3.91$, $p = .005$. Beta coefficients for each trait are displayed in Table 2. As expected from the canonical correlation analysis, Openness was the strongest predictor for both social attention measures. Interestingly, Extraversion appears to be much more influential in predicting average fixation duration whereas Agreeableness appears to be more influ-

Table 1
Values of the first canonical function for Big Five personality traits predicting attention towards eyes. Structure coefficients (r_s) greater than |.30| and communality coefficients (h^2) greater than 30% are bolded.

Variable	Standardized canonical coefficient	r_s	h^2 (%)
Big Five			
Extraversion	.591	**.338**	11.42
Agreeableness	.545	**.360**	12.96
Conscientiousness	.012	.254	6.45
Neuroticism	.349	.114	1.30
Openness	−.864	**−.649**	**42.12**
Social attention			
Average fixation duration	.469	**.795**	**63.20**
Total fixation time	.689	**.910**	**82.81**

Note: Because only one function was noteworthy in this case, the communality coefficient is equal to the squared of the structure coefficient ($h^2 = r_s^2$).

Table 2
Standardized beta coefficients, *t*-test values, and *p*-values for Big Five traits predicting average fixation duration and total fixation time towards eye regions. Bolded values denote $p < .05$.

Variable	Standardized beta coefficient	*t*-Test value	*p*-Value
Average fixation duration			
Extraversion	.385	2.82	**.007**
Agreeableness	.228	1.65	.105
Conscientiousness	−0.09	−.689	.494
Neuroticism	.064	.471	.640
Openness	−.425	−3.01	**.004**
Total fixation time			
Extraversion	.248	1.89	.066
Agreeableness	.314	2.36	**.023**
Conscientiousness	.074	.565	.575
Neuroticism	.258	1.98	.054
Openness	−.455	−3.42	**.001**

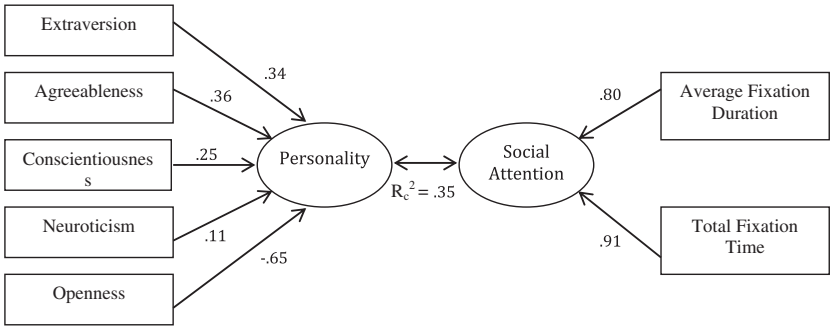

Fig. 1. A graphical depiction of the first canonical model between personality and social attention, with the structure coefficients (r_s) for the predictor variables shown on the left, and the dependent variables on the right. The squared canonical correlation coefficient (R_c^2) between the two variable sets was .353, meaning the function explains 35.3% of the variance between the two variable sets.

Table 3
Correlation matrix of all variables with Pearson's *r*-values. Bolded values denote $p < .05$.

Variable	Average fixation duration	Total fixation time	Extraversion	Agreeableness	Conscientiousness	Neuroticism	Openness
Average fixation duration	1.00						
Total fixation time	**.472**	1.00					
Extraversion	.273	1.06	1.00				
Agreeableness	.138	.217	−.015	1.00			
Conscientiousness	.027	.201	.034	.202	1.00		
Neuroticism	−.052	.134	−.145	−.203	−.058	1.00	
Openness	−**.293**	−**.360**	.226	.124	−.153	.044	1.00

ential in predicting total fixation time. A correlation matrix for all the variables is displayed in Table 3.

4. Discussion

The aim of the present investigation was to examine whether the general personality of the viewer influences social attention as measured by looking behaviour to the eye regions of other people in social scenes. As described in the introduction, research on the AQ suggests that it is an unreliable indicator of looking behaviour. However, past work also suggests that the AQ measures a personality trait that is independent of the Big Five personality traits (Wakabayashi et al., 2006). Thus, we took a more generalized approach to investigate the relation between personality and social attention. Our findings indicate that personality, as assessed by the Big Five, relates to eye movements towards social stimuli, with Extraversion and Agreeableness both relating positively to the amount of attention committed to the eyes of others, and Openness to Experience relating negatively to the attention committed to eyes. The variance in social attention explained by the Big Five is in line with other studies that have explored how differences in the viewer can be predictive of eye movement behaviour. For example, Tseng, Carmi, Cameron, Munoz, and Itti (2009) found that top-down subjective factors explained about 31% of variance in center bias behaviour in dynamic scenes, around double the variance that could be explained by bottom-up saliency factors alone.

The Extraversion and Agreeableness findings dovetail with previous reports that these traits relate directly and positively to the quality of live social interactions (Berry & Hansen, 2000). Moreover, Extraversion has been linked to reward circuitry, especially those arising from positive emotions (e.g. happy faces), which is thought to underlie the sociability that is prominent in extraverts (Canli, Sivers, Whitfield, Gotlib, & Gabrieli, 2002; DeYoung et al., 2010). Agreeableness, on the other hand, is linked to empathy and prosocial behaviour (Graziano, Habashi, Sheese, & Tobin, 2007). Interestingly, our regression analysis found Extraversion to be a stronger predictor of fixation duration, while Agreeableness was stronger in predicting total fixation time. While it is premature to draw any strong conclusions, recent research has suggested that areas related to Extraversion, in particular, the amygdala and orbitofrontal cortex (Canli et al., 2002; DeYoung et al., 2010) are associated with direct gaze contact and duration (Kuzmanovic et al., 2009; Nummenmaa & Calder, 2009). On the other hand, areas related to Agreeableness, such as the posterior superior temporal sulcus and fusiform gyrus (DeYoung et al., 2010), respond to facial features and social cues more generally (Nummenmaa & Calder, 2009). Thus, it could be that those individuals scoring high on Agreeableness do not dwell on the eyes, but cycle through a number of facial features (including the eyes). At present these must remain as viable possibilities that warrant further investigation. In summary, our finding that Extraversion and Agreeableness load positively on attention to eyes is convergent with recent work that suggests extraverts find social stimuli to be rewarding, while people who score high on Agreeableness are more responsive to finding intentionality in social cues (DeYoung et al., 2010). Additionally, our study highlights the need to closely analyze different measures of social attention, as distinct biological mechanisms may be responsible for different expressions of social attention (Kuzmanovic et al., 2009).

Neuroticism and Conscientiousness were unrelated to social attention, even though both traits have been found to relate to the AQ (Austin, 2005; Wakabayashi et al., 2006). We suggest two reasons for this result. Firstly, the AQ may be an unreliable measure of looking behaviour. Secondly, Neuroticism and Conscientiousness capture more internal aspects of personality that do not relate to the social world. Indeed, lexical terms that describe both traits are largely non-social. For example, organization and efficiency for conscientiousness, and emotional stability and insecurity for neuroticism (Goldberg, 1990).

Our finding that Openness to Experience relates negatively to attention diverges sharply from past work that has found that in *live* interactions, Openness relates positively to the amount of visual attention the participants give each other (Berry & Hansen, 2000). This contrast adds to the growing body of evidence that insofar as social attention is concerned, there can be profound differences in committing social attention to real people versus images of people (Risko, Laidlaw, Freeth, Foulsham, & Kingstone, 2012). To wit, someone who scores high on Openness to Experience may be intrigued by meeting someone new and thus devote much attention to engage that real person. However, in a laboratory setting, when presented with images of people that cannot interact back, there is no potential for a social interaction (cf. Wu, Bischof, & Kingstone, 2013). This is precisely the type of situation that participants who are high on Openness to Experience may find least rewarding. Openness is related to imagination and the tendency to give complex narratives (McAdams et al., 2004). One possibility is that, when given a neutral task such as "look normally", those who scored high on Openness may in fact be trying to extract meaning and create narrative by looking at the various objects in the scene.[1]

We believe our finding that personality is related to attention towards eyes is relevant to the broader literature on the underlying mechanism involving social attention. While there is mounting evidence that gaze selection is relatively automatic (Laidlaw, Risko, & Kingstone, 2012), and may be subserved by a phylogenetically primitive subcortical system (Levy, Foulsham, & Kingstone, 2013), there are other factors that may influence the degree to which attention to eyes is selected. That is, while *initial* gaze selection is relatively automatic, the number of times this selection is reiterated may depend on a number of "high level" factors. The situational context in which the observer is embedded is one such factor that has recently been found to be important (Laidlaw et al., 2011; Risko, Laidlaw, et al., 2012; Wu et al., 2013). The

[1] Supporting this theory, our data also shows that numerically Openness had the greatest influence on social attention in scenes with only one person or scenes devoid of action. Those who score high on Openness may be seeking to extract meaning in other parts of the scene when the meaning is not revealed by social interaction or activity. However, as there were only a few scenes in each subcategory, we hesitate to propose this result as anything more than suggestive.

present work suggests that the general personality of the observer is yet another important factor.

Our study supports the notion that the three traits: Openness to Experience, Extraversion, and Agreeableness, are uniquely related to social behaviours more generally (Berry & Hansen, 2000). Future research may wish to decompose this relationship between the selection of the eyes of others (Birmingham & Kingstone, 2009), and the subsequent effects that this selection has on the allocation of attention, e.g., gaze-cueing (Friesen & Kingstone, 1998). Indeed, researchers have wondered to what degree individual differences in gaze-cuing are in fact due to differences in gaze selection (Frischen et al., 2007).

Our study brings about yet another wrinkle to the lively discourse regarding the limitations and generalizability of findings that emerge when studying social attention using real people versus images of real people (Risko, Laidlaw, et al., 2012). Our results, coupled with those from Berry and Hansen (2000), suggest that personality interacts profoundly with social context to bring about differences in how one attends to others. This idea may also explain the previous contradictory findings between AQ and social attention in live settings (Freeth et al., 2013; Laidlaw et al., 2011). While both studies took place in real-world settings, the Freeth et al. (2013) study involved a friendly one-on-one interaction whereas the Laidlaw et al. (2011) study involved a potentially awkward waiting-room situation. There are different norms underlying these two situations, which may lead to divergent behaviours (Wu et al., 2013). Personality differences may interact with social context to exacerbate differences in attention allocation.

In conclusion, we found that personality as assessed by the Big Five is related to gaze selection when free-viewing static images. Specifically, an increase in Extraversion and Agreeableness is related to an increase in the attention one commits to the eyes of others, while an increase in Openness to Experience is related to less attention being committed to the eyes depicted in static images of people. We discussed several of the many potential lines of inquiry that emerge from this study – questions that no doubt will bring personality and social attention researchers into closer collaboration. We hope that this study inspires further research into the relationship between who one is and how one sees the world.

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